NATURE

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Editorial and Publishing Offices:

MACMILLAN & CO., LTD., ST. MARTIN'S STREET, LONDON, W.C.2.

Telephone Number: Whitehall 8831 Telegraphic Address: Phusis, Lesquare, London

The annual subscription rates are: £2 12 0 British Isles, £2 17 0 Foreign, payable in advance

Advertisements should be addressed to

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Vol. XIII, No. 3, July, 1938. 12s. 6d. net.

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Vol. 142 SATURDAY, JULY 16, 1938 No. 3585

Science and Government

A LECTURE entitled "Science and Government", recently delivered to the Royal Philosophical Society of Glasgow by Prof. J. Graham Kerr, raises questions of the widest concern. Its theme is the utilization of science in the interests of the community and the inculcation of scientific methods of thought into governance—matters outside the sphere of party politics. Prof. Graham Kerr is a believer in democracy and prefers our bureaucratic system to that of totalitarian States; the former is slow in action but flexible, while the latter, though more speedy in action, has a certain rigidity, and its dependence on the ability and principles of the individual renders it liable to a sudden collapse. He compares the bureaucratic machine to an organism. Its increase in size contains its own elements of danger in the development of a longer and longer chain of organization, which is liable to have weak links and thus to break down under strain.

It is unquestioned that the organized modern State depends on the successful applications of science, alike to the feeding, motility, health and recreation of the whole population, as well as in securing the safety of the community from foreign aggression. The development and efficiency of services in these matters are the sole concerns of several ministries. The business of their executive officers is, for the most part, the application of regulations in their different spheres, but secondarily they have to advise the ministers responsible to Parliament. As the higher departmental staffs consist of individuals generally chosen for ability by examinations in which science, being unprofitable, is a subordinate subject, ministers can scarcely rely upon their advice in major concerns; if capable of understanding, they have not the time—perchance, the inclination—to keep abreast of the advances of science. Hence the institution of advisory committees, strongly endorsed by Prof. Graham Kerr on account of their "cold-blooded, judicial consideration" of questions placed before them.

The personnel of these committees, having been properly selected, must subject the ministers to no "fussy interference", while, above all, a ministry must in its turn try neither to persuade nor to bring pressure by raising purely administrative or political difficulties. As a general principle, it is suggested that every administrative ministry, civil and military, should have its own advisory committee, and examples of the success of these committees are given. In all cases where a ministry has its own scientific department, it should help its members to discuss their scientific problems with colleagues whose activities are more concerned with the fundamentals of science. In the modern civilized State, however, all these matters depend ultimately for their success on the general educational system, which is considered by Prof. Graham Kerr to demand a thorough overhaul as a matter of national concern.

Considering the topic 'science and government' more widely, we regret that Prof. Graham Kerr did not let his thoughts wander to the Empire. The Dominions have made considerable advances in education by the evolution of new technique and the development of almost new subjects—and in most of their interests they have independent experts upon whom they can call for advice. The Colonies have practically no experts apart from those commercially and personally concerned. Colonies represent earlier stages in the evolution of civilized States and independent democracies

than do Dominions. Their environmental conditions are obviously immature. Health is all-important; food has to be produced, perhaps new foods introduced; transport should be easy; luxuries from abroad must be balanced by excess production culminating in exportation; and lastly all questions concern at least two races of man in each colony. Here, as in the home State, success depends on experts, between them capable of applying each branch of science. More often than not these experts are private individuals who risk their wealth in practical business, an excellent arrangement provided that this business is kept duly subordinated to the interests of the colony.

The executive officers of a colony have to devote their energies to keep the machinery of government smoothly running and to this end have now some training enabling them to consider the inter-relationships of races living together. How far are these individuals, largely chosen for their informative and cultural education, capable of dealing (for example) with food production and, perchance, the reports of specialist officers, if they themselves are ignorant of the basal methods employed in such work? Obviously governors of colonies scarcely belong to the present age, but how many of their executive officers have been trained in the methods of science? What value is placed on such knowledge in their selection? In the probationary period, before proceeding to colonies, what time is devoted to training in the scientific method, if the individual is chosen for other sides of learning? In other words, have the methods in the governance of the Colonies kept pace with the scientific evolution of the last decades? The Colonial Office alone has the information necessary for reply. In democracy, colonies must be held by the consent and goodwill of the governed, and the Empire demands an efficiency of management leading through prosperity to a permanency of union.

Lastly, from our point of view, the payment and pension problem has long been a matter of concern, the conditions in the scientific services being inferior to those in the administrative. In a statement to Parliament*, the Colonial Office appreciates the necessity of a "Standardisation of Conditions", which, since "a uniform pension rate has been laid down as suitable for officers of the unified Services", can only mean a gradual rectification of a grievance of scientific workers. This is a necessary step to secure the best recruits for the scientific services, the training for which is long and intensive and in which only men of high ability are required. The Colonial Office thereby attains a liberty of action which previously it could not exercise. No longer need it transfer an officer who has made an intensive study of the scientific problems of one colony to a post in another, thus promoting him while rendering his study nugatory. If the Colonial Office requires, he can now be called upon without injustice to identify himself with the particular colony in which his success and perhaps affection lie. The old system of promotion, solely by transference, was often unsuited to the scientific services and made permanency in any colony a sign of ineffectiveness.

* The Colonial Empire in 1937–38: Statement to accompany the Estimates for Colonial and Middle Eastern Services, 1938. (Cmd. 5760.) Pp. 79. (London: H.M.S.O.) 1s. 3d. net.

Principles of Factorial Experiments

The Design and Analysis of Factorial Experiments

By F. Yates. (Imperial Bureau of Soil Science. Technical Communication No. 35.) Pp. 96. (Harpenden: Imperial Bureau of Soil Science, 1937.) 5s.

THE publications of the various Imperial Bureaux are necessarily of very unequal scientific value, and naturally also, appeal to very different bodies of scientific workers. Their format and presentation are not such as to excite an expectation of material of wide interest. Thus, the reader who encounters first in large letters "Imperial Bureau of Soil Science", and then the somewhat repellent caption "Technical Communication No. 35", is not well prepared for the exceptional interest of the material presented by Mr. Yates in the monograph under notice. It should, therefore, be stated at once that this particular publication has been awaited eagerly by experimenters in all parts of the world, and that in providing, not only a much needed compendium of well-established designs, but also the practical solutions of a number of the problems outstanding, it will more than justify the expectations that have been formed.

For at least a century, experimenters have felt

the need, and have frequently attempted, to incorporate two or more factors in the same experiment. Two of the classical fields at Rothamsted, dating from 1852, are such attempts. Unfortunately, they did not know how to reap the great advantages of such arrangements, without incurring even greater drawbacks. A long history, involving on one side the experimental exploration of the nature of the experimental errors; on the other, the gradual development of adequate statistical techniques; and, finally, the recognition of the conditions upon which the mathematics could be made applicable to the experimental facts, lay between the aim and its fulfilment. It is the knowledge acquired in this long process, and the changes in point of view which this knowledge has induced, that have brought factorial experiments to the fore. Designs formerly felt to be extravagant, or dangerously ambitious, are now known to be demonstrably more economical in time and money than any available alternatives. They require, however, careful planning and foresight. When high precision is aimed at, they may be very intricate. Their statistical reduction will defeat the novice who has not studied the subject. Only those who feel that this is too high a price to pay for efficiency and comprehensiveness will be tempted to ignore the opportunities which the work of recent years has revealed.

Of the seventeen sections, the first is introductory. It contains a clear brief statement of the purpose of the memoir. The next two sections deal with a three-factor experiment with eight experimental combinations, this useful type serving excellently to illustrate the notation for the recognition of particular components. The scheme of progressive sums and differences (p. 15) is an especially valuable feature, and will save much tedious calculation.

Confounding and partial confounding are introduced in Section 4 with the same example. The real advantages of partial confounding, however, only appear in the following section with the discussion of general 2^n designs, that is, of the simultaneous use of n factors at two levels each. The reader should note the elegantly balanced sets of confounded components for experiments with thirty-two combinations in blocks of eight, or of four (p. 25). A practical example of confounding thirty-two combinations in blocks of eight, shows a gain of more than 48 per cent in the precision of the components conserved. Since the loss is only one fifth in the interactions of three or of four factors, even the components partially confounded would in these circumstances have 19 per cent higher precision than without confounding.

The treatment of factors at two levels only is completed in Section 8, with a highly original series of designs for confounding in Latin squares. This is an idea which considerably influences the later sections. In the introduction it is suggested that the loss of precision which, prior to the introduction of confounding, used to accompany the simultaneous testing of large numbers of treatment combinations, was due principally to the necessity of abandoning the Latin square. It is therefore of importance that 4×4 and 8×8 squares can be used very efficiently. A wide choice of designs is available, and the section will repay very careful reading.

With Section 9 we come to the use of factors at more than two levels. The section is excellently planned to give the reader an adequate background for the application to these more complex problems of the many devices already applied to factors tested at two levels only. The most difficult sections are devoted to these. Especially valuable is the notation for the interactions of a number of factors at three levels, the understanding of which greatly facilitates the appreciation of the later designs.

A point of very general interest emerges in the last section. The great difficulty of factorial designs, which the previous sections have shown how to overcome, lies in the large number of combinations which need to be compared. The technique of confounding and partial confounding, in answering this difficulty, incidentally shows the way to deal with the typical problem of practical plant improvement, where the geneticist is faced with the testing of a host of promising segregates obtained from crossing. In the quasi-factorial designs these are treated *as if* they were the combinations of two or more 'factors', and in this way a large number n of varieties may be tested in blocks of only $n^{1/2}$ or $n^{1/3}$ plots. This represents an enormous gain in practical efficiency; won, in this case, at the cost of some complexity in the statistical treatment of the data. Triple lattices based on the Latin square ought to be much more widely used when their advantage is appreciated, and when high replication is available the balanced lattices or 'balanced incomplete blocks' provide a type of experiment in which all comparisons are of equal precision (whereas with the unbalanced lattice they are slightly unequal), and the computations are correspondingly simplified.

The lattice square is a beautiful application of the same principle using the elimination of rows and columns (Latin square) in place of only the elimination of differences between blocks. To compare forty-nine varieties with only four replications in four Latin squares of which the eight subdivisions by rows and columns form a mutually orthogonal set, is an achievement astonishing in

its simple ingenuity. The last section, in fact, is all too short, and might perhaps have been given space at the expense of Section 16, devoted to split plot designs. Every possessor of the monograph at least ought to examine in relation to his own problems the possibilities of this last section.

The details of the arithmetical analysis are given throughout, so that no experimenter need hesitate to apply even an intricate design, if it appears to suit his requirements, for fear that the data obtained will prove unmanageable.

R. A. FISHER.

Atomic Realism

The Renaissance of Physics

By Dr. Karl K. Darrow. Pp. viii + 306 + 17 plates. (New York: The Macmillan Company, 1936.) 12*s*. 6*d*. net.

DR. DARROW'S capacity for making rough places smooth is well known and is admirably shown in this popular exposition of modern advances in physical science. For the most part he has chosen to be guided by the motto which Kamerlingh Onnes proposed for physics, *Door meten tot weten*, "through measuring to knowing"—a phrase that carries one back to the fifty-year-old pronouncement of Kelvin that it is not until you have measured a physical quantity that you can really begin to say you know something about it. There is room for very pretty argument in both statements; the shape of the earth—sphere, spheroid, ellipsoid, and finally, with a gesture of despair, ge-oid—has become more elusive as precision of measurement has increased; but that may be let pass for the nonce.

It is a fact that a great many popular expositions of modern physics concern themselves more with the presentation and discussion of results than of methods, and the inquiring layman thereby loses some entrancing stories of experimental technique and possibly gains some very warped notions of the manner in which the experimenter has arrived at the astonishing conclusions of the last generation. Indeed, some of the popular expositions leave one with the impression that the subject has "just growed", and give not an inkling of the experimental methods that lie behind it all. Dr. Darrow's book is a wholesome corrective of such views. He has an eye for the essential in a physical experiment, and the intelligent reader will rise from the perusal of this work with some knowledge, not only of what has been done, but also of how it has been done.

It is needless to attempt to define the scope of the book with any fullness of detail. It is sufficient to say that waves and corpuscles and the structure of the atom are topics which are discussed at length, when and only when the reader has been given a sound grounding in the relevant parts of the elements of classical physics; and the grounding is none the less thorough even though the work is almost entirely devoid of mathematics. It is significant, however, that the name of Heisenberg and the terms "uncertainty" and "indeterminacy" do not appear in the index.

It is with mild regret, rather than surprise, that one finds Dr. Darrow in the ranks of the atom see-ers (not *seers*, which is another matter). He directs our attention to the observer who, marking a luminous trail in the sky, says, "I see a shooting star", and makes a parallel between that experience and the experience of him who, observing a trail on a photographic plate, exclaims, "I see an atom—or a sub-atomic particle". Moreover, he reminds us that "as lately as 1909, a brilliant and distinguished man could print: 'Atoms, like molecules, are fictions. . . . The language of chemists has become so saturated with the phraseology of the atomic and molecular hypotheses, that we speak in terms of atoms and molecules as if they were objects of immediate observation. It must be reiterated, therefore, that this language is figurative, and is not to be taken literally. . . .' Strange words, indeed, to be published in 1909, and re-read in 1936!"

Yes; and they may very well be compared with the words of Lord Kelvin, written but a few years earlier than 1909, in which he avers his belief in the reality and substantiality of the luminiferous ether. The fate of that avowal might well give pause to the enthusiastic atom-realists of the nineteen-thirties.

It does seem that in these matters the man of science is permitting himself to become something of a pseudo-philosopher, and to confuse the model with the reality. Indeed, much of the trouble centres on the use and the misuse of the term 'real'. If I sum up a number of sense-data in the expressions, "This is a table" and "This table is *really* solid", I am using words in a commonsense way to which, I apprehend, no metaphysician would take exception. But it is a different and much more debatable matter when I proceed to say "This table is *really* made up of a cloud of sub-atomic particles and for the most part is *really*

empty space". We are now, in our use of the word 'really' adventuring into philosophic regions of thought and, though it is perfectly true that we may advance through science into philosophy, it is also true that philosophical studies are as technical in character as physical studies and, lacking that technical knowledge, the man of science may find himself suffering a sea-change into a half-baked metaphysician.

Atom, ether, quantum-mechanical model—all these dwell in a conceptual world which we build up to imitate, as closely as may be, the happenings in the world of sense-data in which we move and live. We perceive some such event as a column of mercury in a barometer tube, the 'slow-decaying oscillations' of a torsionally-suspended disk in air, certain groupings of the weights on a balance pan which record the results of a chemical reaction; and we find that the concept 'atom' in our model world best correlates these happenings in the world of perception. The atom does not come one whit nearer reality, using that word in the way originally defined, if we add to our perceptions that of, say, a streak on a photographic plate, or a flash of light on a phosphorescent screen. This is not to say that a concept can never become a reality in the perceptual world—some miraculous change in the scale and powers of our being may bring the atom into the region of direct sense-perception; but until that happens, talk of its reality is just irrelevant. Moreover, when concept becomes percept, it is more than likely that some other feature will be added to the conceptual model to account for the new set of facts in the world of perception.

This considerable digression must, however, not be interpreted as conveying any fundamental criticism of Dr. Darrow's delightful book, which is one of the best and most stimulating of the popular reviews of modern physical science that has appeared during recent years.

A. F.

Planning of Social Progress

The Middle Way: a Study of the Problem of Economic and Social Progress in a Free and Democratic Society. By Harold Macmillan. Pp. ix+382. (London: Macmillan and Co., Ltd., 1938.) 5*s*. net.

THOSE who weary of the puerile aspects of party politics, and think that the 'something rotten' in the State is its economic structure, will welcome this thought-compelling book with its major premise that social changes are ineluctable but amenable to human direction. Fully cognizant of the value of co-operation and of public ownership or control of certain essential services, the author lays down some fundamental rules for peaceful progress along a middle road between socialism and capitalism, which should ensure the safety of democracy and lead ultimately to the highest degree of individual freedom compatible with the general good.

The first rule is to mitigate poverty and to banish that great scourge of civilization—economic insecurity and the fear of it. There must be a minimum standard of living, attainable through a legal minimum wage, higher unemployment benefits, and certain family allowances; and to meet the extra cost of these, industries and services must be made more efficient, a few more of them put under public control, and the whole integrated and rationalized. Private enterprise and the free play of competition are desirable in young and expanding industries, but after that stage co-ordination by the industries themselves, with proper safeguards against monopolistic abuses, becomes necessary, and eventually certain key industries are best transferred to public ownership. Coal, power, transport, a central bank, investments, foreign trade, and essential foodstuffs (including purchase and distribution of milk and other dairy produce, bread, sugar and potatoes) would all in time come under public control, each being managed by a special board in consultation with and supervised by a national economic council.

The above represents but a *coup d'œil* over the vast field covered by this book, which is of remarkable value and free from obvious bias or error (except *grains* for *grams* on page 40). Study of it, however, leaves a doubt whether such reforms would be properly implemented, and if so, how long they would endure, in an acquisitive society ruled largely by individual self-interest. Lasting success would seem to demand an enlightened outlook, which might be achieved by drastic changes in educational methods. Youth must be served that health and "joy through work" be attained, not by means of mass suggestion, dogma and violence, as in the totalitarian States, but by inculcating freedom of thought and expression, reason and persuasion. Economics *and* education are the two vital fronts on which the citadel of human discontents must be attacked. E. H. T.

Physical Chemistry of Textile Materials

Kolloidchemische Grundlagen der Textilveredlung

Von Dr. Emmerich Valkó. Pp. xi + 701. (Berlin: Julius Springer, 1937.) 60 gold marks.

IN this book, Dr. Valkó gives a remarkably comprehensive account of the present position of physico-chemical investigation in relation to many aspects of the manufacture of textile materials. The title is perhaps not altogether fortunate, since the scope of the book is wider than it suggests. Moreover, the author is well aware that modifications of the physical characteristics of the various textile fibres are *fundamentally* determined by the chemical nature of the substances composing them, and he also recognizes that nothing is gained by simply labelling obscurities in behaviour as 'colloidal phenomena'.

The first chapter consists of a very useful description of the chemical constitution and molecular and crystalline structure of cellulose, wool keratin and silk fibroin. It includes an able critical review of the results obtained from attempts to estimate the chain-length of cellulose molecules. In Chapter iii an interesting account is given of the arrangement of the molecules in cotton, wool and other fibres, as deduced from their optical and mechanical properties, and from their behaviour in the diffraction of X-rays, the absorption of liquids and in other respects. Evidence for the existence of structural units in the form of submicroscopic molecular aggregates ('micelles' or, more specifically, 'crystallites') is presented in a judicious fashion. In particular, it is emphasized that optical and mechanical anisotropy of the fibre cannot be regarded as direct proof of the presence of crystallites. Chapter iv deals with the sorption of water by the fibres, and the consequent alteration in their dimensions and mechanical properties. The nature of the sorption process is fully discussed in the light of the available information, due weight being given to the data obtained in studies of the heat of sorption, sorption hysteresis, and the specific volume of the fibres.

Chapter v is devoted to the consideration of the chemical and physical behaviour of wool and silk when treated with solutions of acids and bases, and Chapter vii deals with various aspects of the mercerization of cotton. While clearly explaining how the principles of the Donnan membrane equilibrium may be operative in the swelling of wool, silk and cellulose, the author is careful to indicate the limitations of the osmotic theory. In reviewing work on the absorption of alkali by cellulose, Dr. Valkó appears to have overlooked an investigation by Hibbert and co-workers (1930), which provides further evidence in favour of chemical combination in equal stoichiometric proportions. The 'degeneration' and 'activation' of cellulose, and the modification of wool by the action of chlorine and other reagents, are considered at length in Chapters viii and ix. Short chapters on the morphology and histology of fibres, the electrokinetic behaviour of cellulose, and the 'felting' of wool, complete the first half of the book.

The next three chapters, which occupy about a third of the book, deal with the nature of aqueous dispersions of dyes, the principles underlying dyeing processes, and the behaviour of dyes when fixed on the fibres. They form a particularly valuable feature of the book, since the need for a summary of this kind has long existed. It is frequently supposed that in the direct dyeing of cotton, the dye is held in virtue of its colloidal condition. Dr. Valkó shows that, while this view is not supported by the results of recent work with purified dyes, there is reason for postulating an *indirect* connexion between the colloidal character of the dyes and their dyeing properties, in the sense that the forces which produce association of the dye molecules in solution are also responsible for their attachment to the fibre.

An excellent account is given, in Chapter xiv, of the properties (including surface tension) of solutions of 'soaps', using this term in its widest sense. Recent developments in this field are described in detail, since they are of special interest in regard to the elucidation of the state of the soap at the concentrations employed in textile practice. In the following chapter, interfacial phenomena, and the stabilization of emulsions and suspensions, are discussed in connexion with the wetting, washing and impregnation of the fibres. The greater part of the remaining chapter is allotted to the physical chemistry of starch solutions, there being, in addition, short sections on gum arabic, methyl cellulose, and the processes of sizing and printing.

The author designedly excludes consideration of purely mechanical processes and processes involved in the actual formation of artificial fibres. Within the limits imposed, however, little of importance appears to have escaped mention. Certainly full justice is done to the work of British investigators.

The book should facilitate collaboration between specialists in the industries concerned, and prove stimulating to all interested in colloid chemistry. Though packed with information, it is very readable, as Dr. Valkó maintains a lucid and agreeable style throughout. The diagrams are very numerous and the book is well produced.

T. R. BOLAM.

Historic Haunts of England

By Gwen Woodcock. Pp. xiii+368+48 plates. (London: Alexander Maclehose and Co., 1938.) 7*s*. 6*d*. net.

IN the phrasing of a bygone age, Mrs. Woodcock combines instruction with entertainment. In this companion to her volume on Scotland she has selected more than fifty places of interest scattered throughout England and has given her readers a bird's-eye view of the salient features of the history of each. Topographical and architectural details are strictly subordinated to elucidating the story. This is told admirably in a graphic and succinct narrative without unnecessary ornament. The author's interest is catholic, and she covers not only picturesque towns, such as Dover and Rye, Burford, Beverley, or York, but also castles, great houses, such as Knole and Hatfield, and ruins and prehistoric monuments, Kenilworth, Avebury and Stonehenge. Illustration is generous and excellent.

Lest a necessarily brief account of a book containing much, but not an overload of detail, should convey the impression that it is no more than an excellent 'gossiping guide', it may be pointed out that from the author's judicious selection of incident and the frequent juxtaposition of a number of distinct narratives of events drawn from identical periods in time, certain general trends in the history of the English people emerge. Such are, for example, the forces which welded the English, a people of so diverse an origin, into one, or the development in the relations of nobles and people and the cognate matter of the divergencies in form and character of the English township and the origin of these divergencies, some towns being appanages of a great house, such as Arundel and Warwick, others groupings of independent burgesses, arising with the early growth of trade, commerce and industry, as do the towns of the Cotswolds, or the Cinque Ports, which base their independence on the sea.

(1) Wild Flowers in Britain

By Robert Gathorne-Hardy. (British Nature Library.) Pp. 120+104 plates. (London: B. T. Batsford, Ltd., 1938.) 8*s*. 6*d*. net.

(2) Everyman's Wild Flowers and Trees

Five Hundred of the British Wild Flowers, Trees, Shrubs, Grasses, and Ferns, described and illustrated, 384 in colour after Sowerby's "British Wild Flowers", and 120 from line-drawings by the Author. By Miles Hadfield. Pp. vii+184+32 plates. (London: J. M. Dent and Sons, Ltd., 1938.) 6*s*. net.

DURING the past few years there has been a spate of illustrated guides (not necessarily floras) to the plant life of Great Britain, especially the flowering plants. Some have been scarcely anything but vehicles for artists' impressions of attractive flowers, while others have proved very helpful not only to the amateur naturalist but also to the professional botanist. Now, therefore, in any new work on British wild flowers, we may feel justified in demanding some distinguishing features to warrant its publication.

(1) In Mr. Gathorne-Hardy's book we see such features. His ultimate aim is to instruct the amateur in the pleasures rather than the science of botany; and he would be a very hardened reader who does not become captivated by the author's pleasing style of description. He writes with such literary prowess and enthusiasm for his subject that the book makes good armchair reading. Thus it might fail in its main purpose, but it would be failure along the right lines, because the book is so beautifully illustrated. The photographs (many of them full-page) are some of the best we have seen. They have clearly been chosen with care from the work of the best living Nature photographers. Mr. John Nash's colour lithographs make an enchanting decoration to the whole work. Botanists and all other Nature lovers should welcome this book as a distinctive addition to a subject rather over-burdened in books.

(2) Mr. Miles Hadfield's book comes under a different category, since instead of putting the beauty of plant life in his book he puts the layman reader in the way of finding it in Nature for himself. The illustrations are useful for identification purposes only; but that was obviously intended. The author's main aim is to extend the scope of the book to deal not only with herbs, but also with trees, shrubs and ferns by omitting the rarer species which only the skilled botanist is likely to recognize. The book opens with descriptions of classification and naming of plants, the structure of leaves and flowers, and means of identification. This is followed by illustrated descriptions of five hundred plants, grouped in families. A distinctive feature of the work is the consideration of the economic value of certain plants, garden relations and the meanings of the botanical names of plants. The author is to be congratulated on the production of a really useful book.

Clowes and Coleman's Quantitative Chemical Analysis: an Intermediate Text-Book

Edited and revised by Dr. D. Stockdale and J. Dexter. Fourteenth edition. Pp. xiv+617. (London: J. and A. Churchill, Ltd., 1938.) 18*s*.

IN this new edition of a well-known text-book the type has been completely reset and a large part of the text rewritten. Additions include accounts of the gravimetric and volumetric determination of aluminium and magnesium by 8-hydroxyquinoline, the colorimetric determination of aluminium, the use of the chromate radical in the determination of barium, lead and sulphates, ferrous phenanthroline as an internal redox indicator, a brief introduction to the use of ceric sulphate, and the analysis of cupronickel by salicylaldoxime. The book thus includes some well-tried modern methods of analysis.

The sections on the analysis of water, foods, oils and fats, and gas analysis have been retained, since although these subjects are now best dealt with in special treatises, the processes included provide very useful introductions for the senior student, and also enable the teacher to set alternative exercises in special cases. The book is a thoroughly sound and accurate one and its continued popularity may be predicted.

Vāgbhaṭa's Aṣṭāṅgahṛdayasaṃhitā
ein Altindisches Lehrbuch der Heilkunde. Aus dem Sanskrit ins deutsche übertragen mit Einleitung, Anmerkungen und Indices. Von Dr. Luise Hilgenberg und Prof. Willibald Kirfel. Lieferung 1. Pp. iv+64; Lieferung 2. Pp. 65–128; Lieferung 3. Pp. 129–192; Lieferung 4. Pp. 193–256. (Leiden: E. J. Brill, Ltd., 1937.) 3.50 guilders each part.

OF the early Indian treatises on medicine, that of Vāgbhaṭa is one of the most important. The author flourished at the end of the eighth century, A.D., and although translations of his works have appeared, he seems to have remained to a large extent unrecognized and unknown. He divides his matter into sections. In Part 1, theoretical principles are considered, based upon the conception that "The chyle, blood, flesh, fat, marrow and sperm are the seven bodily elements that may become corrupted". Towards the end of this section, various surgical instruments are described and pictured—forceps, bone and lion forceps, straight and curved needles, saws, and others—all much like those used at present. Certain surgical procedures are also described, such as methods for the removal of foreign bodies from wounds. Part 2 deals with the physiology of the body, commencing with conception, pregnancy and birth, and Part 3 with the etiology of disease, discussing fever, coughs, respiratory affections and heart disease, consumption and urinary troubles, abscesses and abdominal complaints.

The translation appears to be a scholarly one, an attempt is made to convey the exact meaning of the original, and in order that there shall be no doubt the Sanskrit word is frequently given in brackets after its German equivalent. Further, the various plants, etc., comprised in Vāgbhaṭa's materia medica are identified so far as possible. We await with interest the completion of the work.

Aristotle
Parts of Animals; with an English translation by Dr. A. L. Peck; Movement of Animals; Progression of Animals; with an English translation by Prof. E. S. Forster. (Loeb Classical Library, No. 323.) Pp. v+556. (London: William Heinemann, Ltd.; Cambridge, Mass.; Harvard University Press, 1937.) 10*s*. net.

HERE is the Greek text, faced by excellent translations, of the three works of Aristotle of most interest to students in animal physiology, namely, "Parts of Animals", "Movement of Animals" and "Progression of Animals". Dr. Marshall's "Foreword" sets the right key for the reader, namely, composition leading to function, first tissues consolidated into organs. Aristotle is altogether charming; his method is that of science—and students and the dilettanti, who read, will be delighted. The food of plants "is already concocted before it enters them, and in return for it they yield their fruit and seeds". Horns on the head "offer the least possible hindrance to the movements of the body in general". "The Progression of Animals" is quite a basal treatise for research, so popular to-day, on the swimming and other movements of animals.

The Sturge Collection:
an Illustrated Selection of Foreign Stone Implements bequeathed in 1919 by William Allen Sturge. By Reginald A. Smith. Pp. viii+131+plates12–16. (London: British Museum, 1937.) 21*s*. net.

THIS volume, dealing with stone implements from foreign sites, completes the publication by the British Museum of the Sturge Bequest, the vast collection of stone implements bequeathed to the nation by Dr. Allen Sturge, who died on March 27, 1919. The first volume by Mr. Reginald Smith dealt with implements from sites in Britain; and in the volume now issued the same authority has selected a representative sample of the remaining implements. Of these the greater number come from France, but other sites represented are in the various countries of Europe, Asia Minor, Egypt, Africa, north, east, west and south, Palestine, India, the Far East and Australia. The American section is regarded as ethnographical, and has been omitted.

As the basis of a scientific investigation, the collection suffers, according to the modern orientation of archæological studies, from lack of adequate documentation; but as a whole the assemblage of so vast a collection of specimens, representative in type, is in itself of immense value. Its use is facilitated by the succinct but admirable explanatory paragraphs which Mr. Smith has prefixed to the descriptive notes on each group of specimens selected for illustration, these being arranged under sites on a geographical basis of distribution, taking Britain as its starting-point. The references to the more important literary sources for each site are invaluable as an *aide-memoire*, as well as a guide.

An alphabetical list of sites represented in the collection also serves as an index.

Qualitative Inorganic Analysis
By A. J. Berry. Pp. viii+147. (Cambridge: At the University Press, 1938.) 6*s*.

PERHAPS the main features of this book which distinguish it from many other excellent text-books on qualitative analysis are: (1) the inclusion of several so-called rare elements (such as thallium, zirconium, vanadium and lithium) which are now less expensive and are also of scientific and technical interest, and (2) the inclusion of many modern reagents (particularly organic compounds) in the descriptions of the reactions of the radicals.

After a short but commendably clear and instructive theoretical introduction, the book deals fully with the reactions of the metals in the order of the usual groups, with the reactions of acid radicals, with the systematic analysis of the metals, and with the examination for acid radicals. The author does not approve of the use of analytical tables, so he omits them; many teachers will wish that they had been included. The directions for group separations are, however, quite clear, and the disadvantages of turning over pages and getting more of the book stained by reagents may be outweighed by some advantages which are not very clear to the reviewer.

Antarctica and Glacial Ages

By Prof. E. W. MacBride, F.R.S.

THE effects and causes of glacial ages have been discussed from many points of view—observational and theoretical—and the meteorological aspects of the problem were very clearly presented by Sir George Simpson in his Royal Institution discourse published as a Supplement to NATURE of April 2. What is said in the present article may be regarded as complementary to Sir George's survey of the subject, the point of view being that of a zoologist and palæontologist instead of meteorologist or astronomer. In the collection of the facts embodied in the article, I have had the advantage of help generously afforded me by Dr. Stephenson, geologist attached to the Graham Land Expedition, and by Prof. W. W. Watts.

If we desire to know what a glacial age was really like, the obvious course is to study a part of the world where such an age is still in existence. Greenland and Antarctica are two such regions, but Antarctica is preferable to Greenland because it is of continental size. Antarctica is roughly circular in outline and has a diameter of 3,000 miles. Its area thus works out at about 7,000,000 square miles. The maximum height of the continent is 3,168 metres or about 10,000 feet. This is situated about 200 miles north of the south pole.

The whole continent is covered with a huge ice-sheet through which only the highest peaks protrude as two volcanic cones, Mounts Erebus and Terror. The part so far principally studied is that directly south of South America, in which lies the inlet known as the Ross Sea. The length of the ice-sheet known as the Beardmore Glacier flowing into the Ross Sea is about two hundred miles, but it joins the great barrier ice-shelf which extends several hundred miles farther out to sea and from the outer edge of which great tabular icebergs are constantly being cut off. If we add the breadth of the ice-shelf to the length of the Beardmore Glacier, we arrive at a total extent of ice-flow of about five hundred miles, and this is considerably longer than any glacier the existence of which we have evidence in the Pleistocene Glacial Age. From the evidence of erratics carried on the glacier, Dr. Stephenson has been able to make a rough guess as to the nature of the geological formations buried beneath it. Rocks of the Gondwana age, with coal-seams carrying characteristic fern plants, are present: the Gondwana age is usually described as Permo-Carboniferous. Beneath it are folded schists of the Pre-Cambrian or Huronian age.

Now, rocks of Gondwana age with the same characteristic fossil plants are found also in the Deccan of India, in South Africa, and South America; and it is evident that all four areas formed parts of a southern continent for which the name of Gondwanaland has been adopted. It is clear that this continent during the early part of the Gondwana age enjoyed a mild climate and hence must have been situated a considerable distance from the pole; but later it underwent a severe glaciation known as the Gondwana ice-age. Antarctica, however, which formed part of this continent, entirely escaped this glaciation. We conclude, therefore, that during this period the continent must have drifted across the south pole but that Antarctica, which formed part of its northern edge, escaped this glaciation. The drift then must have originated to the south of Australia, and as Australia itself formed part of Gondwanaland, the drift must have begun after the breaking off of Australia from the rest.

The point which we wish to emphasize is that this—the greatest ice-age of which we have evidence—was not due to the chilling of the atmosphere or of the sea but solely to the high latitudes into which Gondwanaland drifted. Long ago Tyndall pointed out that to describe a glacial age as an age of cold was an entire misconception; for, he said, if we calculated the energy necessary to evaporate the enormous masses of ice embodied in the ice-sheets from the sea we should describe a glacial age as a period of greater heat—not cold. What makes a glacial ice-sheet is the condition that in some part of the earth more snow should fall in winter than can be melted in the following summer. For this condition to be fulfilled not only must there be intense local winter cold but also an abundant supply of atmospheric moisture. These conditions can be well studied in Canada in which I had the good fortune to live for twelve years. In Montreal the average winter snowfall was six feet on the level: drifts up to depths of fourteen feet were common. It was an ordinary experience to travel on ski or Indian snowshoes over the tops of buried fences. The ground under this snow-sheet was practically unfrozen. In

contrast to Montreal, the snowfall at Winnipeg was less than a foot and the ground beneath was frozen to a great depth, and to this circumstance Winnipeg owed its magnificent wheat crops. As the spring began, the surface layer of the soil melted and the wheat grains pushed their radicles into this layer. As the sun grew stronger, the wheat roots grew longer and everywhere they encountered a reserve of water in the freshly melted ice of the soil.

How narrow was the margin which separated Eastern Canada from the inception of a new ice-age may be gathered by the following observations which were made by me. During the whole of one August the back gardens of many Montreal houses were encumbered by vast masses of unmelted snow. Now, the first snow of the winter is expected on November 1, and considerably before that period there are hard ground frosts at night. Even in September nights frosts occur, so that if in this particular autumn these frosts had been a little more continuous, a considerable portion of the August snow-drifts would have survived into the winter, and thus the formation of a new ice-sheet would have been begun.

Up to about 1880 the Pleistocene glacial age was the only one of which we had any geological evidence. When at last the conviction was forced on geologists that there had been a severe ice-age in Permo-Carboniferous times, the usual result followed: there was a wild scamper on the part of enthusiastic pioneers to find ice-ages in all periods of the world's history. Such ages were discovered in Cambrian, Ordovician, Silurian, Jurassic and Cretaceous times, and a fearful mess was made of glacial chronology. The pioneers always forgot that the ultimate cause of ice-ages was not the chilling of the atmosphere but greater evaporation from the sea. As the movement of an ice-sheet produces a mixture of thick clay with large stones, which easily becomes a conglomerate with lapse of time, it was easy to suggest a glacial origin for all the conglomerates which recur in the stratified series. If, however, glacial ages are due to the drift of land into high latitudes, then this drift must be somehow the result of the rotation of the earth and must follow an orderly course; we cannot at will 'ferry' lands over sea and back again in order to satisfy our theories.

There seems, however, to be a consensus of geological opinion that there was a Pre-Cambrian ice-age. The best evidence for this, in fact the only indubitable evidence, is found in Canada. In the Temiskaming region of Northern Ontario, where the Huronian strata have been exploited for the world-famous silver mines of Cobalt, a conglomerate with large boulders has been found. But these boulders, when extracted from the mother-rock, are found to have smooth surfaces marked by parallel striæ exactly like those found on boulders in the Pleistocene boulder clay or, for that matter, in the moraines of recent glaciers. Their glacial origin is, therefore, definitely proved. Other records of Huronian strata from other parts of Canada showing evidence of ice action are almost certainly fragments of the same deposit.

That there has been a northerly drift of secondary rocks since Permian times is shown by Old and New Red Sandstone beds of Europe and eastern Canada. The red colour of these sandstones is due to grains of laterite, but laterite is a degradation product of granite and is only found in tropical regions. At the present day its formation is going on amongst the granite hills of Nigeria.

Whilst the Gondwana ice-age was raging in the south, contemporary beds in Spitsbergen show evidence of a warm tropical climate. There are beds of coal with fossil plants showing evidence of a rich tropical flora.

We have seen that drift into high latitudes affords a complete explanation of all glacial phenomena previous to the Pleistocene. When, however, we approach the consideration of the pleistocene glacial age we find that this explanation is no longer applicable. The Pleistocene glacial deposits are represented both in the northern and the southern hemispheres and were therefore contemporaneous all over the world. Further, in the Pleistocene glacial ages alone, do we find evidence of long-continued interruptions of glacial activity. During these interruptions stratified beds were laid down containing plants, bones and shells bearing testimony to a comparatively mild climate. There seem to have been at least four periods of intense cold separated by milder inter-glacial periods. The cold periods were named by Penck, the Gunz, the Mindel, the Reiss and the Würm. The most interesting thing about these periods is that the bones and tools of the oldest indubitably human race are found in the interglacial interval between the Würm and the Reiss periods.

Since the Pleistocene ice-period was world wide, its cause must be sought outside the south in the sun. If, as we have already stated, the primary cause of these periods is an increase in evaporation from the sea, there must have been increased radiation from the sun. Now some of the irregularly recurrent phenomena of the sun are sun-spots. These are solar cyclones of enormous dimensions and are associated with intense radiation. They are connected with the well-known magnetic storms and with displays of aurora borealis. If, then, during a period extending over several million years there were frequently repeated

increases in solar radiation, we should have increases in evaporation from the sea and consequent increases in precipitation in the colder regions of the earth. The interglacial periods would be associated with few sunspots and reduced evaporation and precipitation. During them the glaciers would gradually shrink, exposing great masses of boulder clay which would be washed away by the melting ice and deposited as thin bands of sand and clay elsewhere. Visitors to Switzerland who have noted the milk-white appearance of the Upper Rhone during the summer months will need no further reminder of the nature of the water issuing from the foot of a melting glacier.

Coleman, in his book ("Ice Ages"), mentions the continental drift theory but withholds his assent on the ground of the colossal forces necessarily assumed, which he holds to be incredible. But, as Sir Thomas Holland has pointed out, there is no possible escape from the conclusion that the tearing asunder of primitive continents and their drifting apart really did take place. Actually Greenland has been caught in the very act of drifting. A Danish observer, Oersted, has measured the change in longitude of a station in the extreme south of Greenland between the years 1922 and 1932. The amount determined was 600 feet, that is, 60 feet a year. If we calculate back 100,000 years, we find that Greenland must have then been lying close to Norway. Now from observations on the annual layers of silt deposited every summer by the streams fed by the melting ice, it has been ascertained that it is about 13,000 years since an ice-sheet covered the whole of Sweden. The great Würmian glaciation may have lasted 100,000 years to judge from the enormous extent of the boulder clay which it produced. On the west coast of Wales the clay and boulders carried by this ice-sheet which had crossed the Irish Sea were piled up to a depth of 200 feet. A period of 120,000 years would carry us back into the interglacial period between the Reiss and the Würm glaciations—the time indeed when Neanderthal man flourished.

When the exposed boulder clay became dried out it broke up into dust, and this under the name of 'loess' was blown about by the wind. In central China this loess is piled up to a depth of hundreds of feet. A similar degradation of soil into dust is taking place in North America.

We must conclude with a few words about the bearing of these climatic changes on evolution. What changes the Pre-Cambrian ice-epoch produced in life we do not know, but the researches of Prof. D. M. S. Watson and Dr. R. Broom on mammals prove that the growth of cold-blooded reptiles into warm-blooded mammals began directly after the Gondwana ice-age. During the Miocene epoch a continuous forest stretched across the Old World from the shores of France to the coast of China. Bones and skulls show that this forest was inhabited by the higher apes, the direct precursors of man; but in Pliocene times a northern drift of the old Africa and the Deccan of India began which, impinging on the tableland of central Asia, raised up the enormous barriers of the Himalayas and associated mountains and in Europe the Alpine chain.

Thus the ape population was cut into a northern and a southern group: the latter continued to find its living in the forest, where remnants of it persist as the chimpanzees, gorillas, orangs and gibbons of to-day. The northern group, however, had to face a more severe climate, the first beginning, in fact, of the Pleistocene ice-age. The forest gave way to steppe and the apes had to change their habits to hunting on the ground, and primitive hunting man was born.

Thus there would be much truth in the epigram: the Gondwana ice-age produced the warm-blooded mammals, the Pleistocene ice-age produced man.

The Organization of Knowledge

THE unprecedented progress of science and its applications during the last hundred years has given rise to a flood of literature, the magnitude of which has dulled our senses into a sort of acquiescence. About two thousand new volumes on scientific subjects are issued annually by British publishers, while the number of scientific papers published in a year throughout the world has been estimated to amount to three quarters of a million. A century ago, a scientific worker was expected and able to digest for himself practically the whole of the original literature of his subject. To-day it is with difficulty that he can keep abreast of a particular part of it, even with the aid of a new type of abstracting and indexing literature, which has been evolved specially for this purpose. If he would seek to know what discoveries, which might be useful to him, have been recorded in other branches of his own and different sciences, he must depend entirely upon such services.

The need for the evolution of this new kind of library *aide memoire* is now universally recognized. Indeed, a terrifying sense of insufficient mental material is beginning to dawn upon the minds of a few individuals, particularly of those whose special interest lies in the domain of the applications of science to the benefit of mankind. For that is not knowledge which we do not know where to find. Nevertheless, the present deficiencies and lack of organization in this new research service seem in danger of being overlooked, and the necessity of assembling and perfecting this mechanism of knowledge is not realized, although, perhaps, as much as fifty per cent of modern technical research could be saved if complete information as to recorded data could be made available.

We need to realize, as Mr. Maynard Keynes has expressed it, that "we do not even know what is to be known", and straightway to set about in earnest to organize a master-key to the vast storehouse of recorded information. This is not a question of merely making bibliographies, but of providing a complete bibliographical service, so that anyone can ascertain immediately exactly what information has been recorded on every new question as it arises.

It was for the purpose of the solution of this important problem that the International Institute of Bibliography was founded by an international conference in Brussels in 1895. To this end the Institute has worked for more than forty years. The data concerning the problem have been ascertained, principles have been evolved, much progress has been made, progress which increases year by year. National sections of the Institute have been founded in many countries. The Institute has sought, with growing success, to link together all those, both institutions and individuals, whose interest lies in the collection, classification and dissemination of information. Last year, at a World Congress on Documentation, held in Paris by invitation of the French Government, and attended by representatives of thirty Governments and forty international organizations, the Institute was recognized unanimously as the controlling international bibliographical organization, its federative character being expressed in the decision to change its name to International Federation for Documentation.

At this meeting it was decided to hold in England the FOURTEENTH INTERNATIONAL CONFERENCE OF THE INTERNATIONAL FEDERATION FOR DOCUMENTATION.

The British Government has extended its patronage, and Sir William Bragg, president of the Royal Society, has accepted the presidency. The chairman of the organizing committee is Dr. S. C. Bradford. The Conference will be held at Lady Margaret Hall, Oxford, on September 21–25, followed by final sessions at the Science Museum, South Kensington, S.W.7, on September 26. Advantage of the meeting being in England has been taken to include joint sessions with the annual conference of the Association of Special Libraries and Information Bureaux. Eminent representatives of every branch of intellectual activity have given their support to the Conference. Papers will be read by leading authorities from many countries. Successful as has been the work of the International Federation in the past, it has tended rather to confine itself to making more easily available the literature relative to the natural sciences and their applications. Opportunity will be taken of the forthcoming Conference to endeavour to secure greater collaboration with bibliographers in other fields, such as those of history, archive work and economics. Special attention to these subjects will be given in the papers to be read.

Among the hundred or more papers which have been offered to the Conference we notice the following: Grundsätzliches zur Frage der Vereinheitlichung und Normung auf dem Gebiete des chemischen Referatenwesens, by Dr. Maximilian Pflücke, chief editor of the *Chemisches Zentralblatt*; Bibliographical tools from the user's point of view, by Dr. J. Holmstrom; Le travail bibliographique internationale dans les domaines des études historiques, by P. Carron, director of the Archives de France; Archives in their relation to other forms of documentation, by Hilary Jenkinson, secretary of the Public Records Office; On the present state of documentation in Switzerland, by W. Janicki, past president of the Swiss National Section of the International Federation for Documentation; and The current German situation in the field of practical documentation, by Dr. A. Predeek, chief librarian of the Technische Hochschule, Berlin.

The titles of the papers to be communicated, together with full information concerning the Conference, are given in the preliminary programme, a copy of which can be obtained on application to the secretary, Miss M. Gosset, Science Library, Science Museum, South Kensington, S.W.7. The programme includes visits to some of the many interesting places in the neighbourhood of Oxford, together with other social functions, such as receptions by the Vice-Chancellor and the Mayor, and a Government banquet in the beautiful hall of Christ Church.

All who appreciate the vital importance of the organization of information will realize that the visit of this Conference to England provides a special opportunity of assisting in the discussion and development of a service which feeds the roots of intellectual progress.

Whales and Whaling

International Conference

UNTIL some ten years ago, modern whaling was conducted almost entirely from land stations, and the most important centres of the industry were in British territorial waters where suitable regulations could be enforced. The development of the modern factory ship led to a great expansion of the industry in the form of unrestricted whaling on the high seas, and the operations extended over a vast area in the Antarctic. The Governments of those nations most interested in whaling realized that unlimited hunting must eventually cause depletion of the stock and the collapse of the industry. An International Conference was therefore held in June 1937, and an agreement was signed by representatives of the Union of South Africa, the United States of America, the Argentine, Australia, Germany, the United Kingdom, the Irish Free State, New Zealand and Norway. By the terms of this agreement, measures were taken for the restriction of whaling, including the imposition of a minimum size limit for various species, the limitation of the Antarctic whaling season to three months, and, with minor reservations, the prohibition of pelagic whaling north of 40° S.

In accordance with the recommendations of last year's Conference, a second Conference was held on June 14–24 last. The purpose of this Conference was to invite the adherence of other countries which had not yet acceded to the previous convention, to examine the results of the new regulations and to consider what further measures might be applied. The following Governments sent delegates: Union of South Africa, United States of America, Argentine, Australia, Canada, Denmark, Eire, France, Germany, United Kingdom, Japan, New Zealand and Norway. An observer also attended on behalf of the Portuguese Government, and the interests of Newfoundland were watched by the United Kingdom delegation.

The Conference noted that although the provisions of the 1937 agreement had limited the scope of Antarctic whaling, it had not succeeded in checking the number of whales killed. Indeed it appears that the number of whales taken in the 1937–38 season was approximately 44,000, which is about 10,000 in excess of the figures for the previous season. This is partly attributable perhaps to the high price of whale oil last year. Had it not been for the agreement of 1937, a still larger number of whales would no doubt have been taken.

The new measures agreed to in this year's Conference are embodied in a protocol which amends the existing agreement, and the discussions and recommendations of the Conference are reported upon in a final Act. The following are among the articles in the protocol.

Factory ships are prohibited from taking Humpback whales anywhere south of 40° S. for a period of a year. There is evidence that the stock of Humpbacks stands in even greater danger than that of Blue whales, and the Conference considered a proposal for the world-wide protection of this species for a year. Agreement to this could not be reached, since many land stations are largely dependent on Humpbacks. Protection in Antarctic waters, however, is expected to save large numbers.

Pelagic whaling is now totally prohibited in the Pacific sector of the Antarctic, south of 40° S. and between 70° W. and 160° W. This applies in the first instance for a period of two years. Although whaling has not so far spread to these waters, it is known that the number of whales there is sufficient to be worth protecting. Practical difficulties militate against the imposition of such a sanctuary in the established whaling grounds, but the new measure may at least act as a check on future expansion.

The open season of three months in the Antarctic remains unchanged, as do the minimum size limits for the various species, but small concessions in size limits have been made for land stations where the whale meat is used as food for local consumption.

The other articles of the protocol include a clearer definition of a land station (a point which provoked much discussion over the status of factory ships working in territorial waters) and minor amendments to some articles in the principal agreement.

The Conference considered a resolution of the Whaling Committee of the International Council for the Exploration of the Sea in the following terms: "The Committee, viewing with alarm the evident decline of the stock of Blue whales, is of opinion that nothing less than limitation of the total amount of whale oil which may be taken in any whaling season can be effective in preserving the stock of the whales from being reduced to the level at which it can no longer be the object of economic exploitation". It was felt, however, that at the present stage it would be impossible to

reach agreement to such a measure, which would involve fixing a global quota each year and arranging to cease all whaling when the quota was reached.

Proposals for limiting the number of catchers attached to each expedition and for limiting the oil production of each factory ship were also abandoned on account of the difficulty of apportioning such restrictions equitably among the various expeditions.

It will be seen then that the new measures agreed upon do not go very far, but the first object of the Conference, which was to secure the prolongation of the existing agreement and the adhesion of additional Governments, has been achieved. The principal agreement has been ratified by the Governments of Eire, Germany, Norway, New Zealand, United Kingdom and United States of America, whilst Canada and Mexico have since acceded to it. The Argentine is enforcing the principal agreement by executive decree, and formal ratification is only a matter of time. It is understood that ratification by Australia and South Africa has been delayed only by constitutional difficulties, and the accession of France and Denmark is expected to follow. The Japanese delegation informed the Conference that its Government was prepared to take steps to accede after the interval of a year, and to observe the principles of the agreement as nearly as possible in the meantime. This undertaking of the Japanese is regarded as of great importance, since that nation is now operating on a large and increasing scale in the Antarctic.

In the final Act it is recommended among other things that the Governments and the whaling enterprises concerned should do their best to encourage the development of whale-marking as practised by the Discovery Committee.

The question of holding a future conference is recommended for consideration in the light of developments. N. A. M.

Obituary Notices

Dr. W. W. Campbell, For. Mem. R.S.

BY the death on June 14 of W. W. Campbell, following that of G. E. Hale, American science has suffered the loss of another astronomer who was also a foreign member of the Royal Society.

William Wallace Campbell was born and bred on a farm in Ohio, the date of his birth being 1862. He graduated in the University of Michigan in 1886, and the soundness of the academic training which he had then received is sufficiently attested by the nature of his later career. A year or two were then spent as professor of mathematics in the University of Colorado, after which he returned to the University of Michigan as instructor in astronomy. In 1891 Campbell joined the Lick Observatory as astronomer. The rest of his active life was connected for forty years with that institution and with the University of California. Retirement came in 1930, and before his death he had made his home in San Francisco.

Campbell became acting director of the Observatory on the death of Keeler, and the appointment was definitely confirmed in the following year (1901). He had in an eminent degree that combination of qualities which is necessary for success in the head of a great observatory in an isolated situation, and in this capacity he had the valuable support of his wife, Elizabeth Ballard Thompson, whom he married in 1892. There were three sons of this marriage, all surviving. He was also fortunate in finding a problem peculiarly adapted to his powers. Keeler, before turning to his classical researches on the nebulæ, had pushed the study of the radial velocity of the brightest stars as far as was practicable by visual means. Further progress required the introduction of photographic methods. The circumstances on Mount Hamilton were exceptionally favourable, but the technical problems involved in avoiding the effects of flexure and maintaining uniform temperature had to be solved by original devices. Campbell developed great skill in dealing with the optical and mechanical problems thus presented, and in the Mills spectrograph he achieved a classical design. Chiefly by this instrument in conjunction with the Lick refractor, the radial velocities of all the brighter stars within the reach of the Observatory were determined with high accuracy in the course of a few years. To complete this new chapter in astronomy, by extending the work to the whole sky, an expedition was equipped and established at Santiago in Chile. The effectiveness of this branch from its beginning, at first under the leadership of Mr. W. H. Wright, is a proof that the success of Campbell's plans was by no means dependent on the famous Lick telescope.

The Lick Observatory, though it possesses a splendid equipment, is generously maintained as a department of the State university, but it has no endowment. For all the expenses of the branch in Chile and the cost of additional instruments as the need arose, Campbell had to rely largely on the generosity of wealthy friends of the Observatory, among whom the late Mr. D. O. Mills and Mr. W. H. Crocker may be specially mentioned. His conspicuous tact and persuasive qualities were clearly shown in gaining this necessary financial support.

Eclipse expeditions occupied much of Campbell's time and thought. In all, he took part in seven:

India (1898), Georgia (1900), Spain (1905), Flint Island (1908), Kiev (1914), Washington (1918) and West Australia (1922), where he obtained results confirming the theoretical value of the Einstein effect. Apart from this, Campbell's main contribution was to the study of the flash spectrum by means of a spectrograph provided with a slit and moving plate, by which the height of the exciting elements in the reversing layer could be accurately recorded. His preparations for an eclipse expedition were a model of organization.

So conspicuous were these powers of organization and administration that Campbell was persuaded in 1923 to become president of the University of California, a position which he retained until 1930 without giving up the control of the Lick Observatory. These were years of notable expansion in the University, which is now perhaps the largest in the world, having more than 15,000 students resident at Berkeley and a total enrolment with other local centres exceeding 24,000. After retirement from the University and from the direction of the Observatory in 1930, Campbell became president of the National Academy of Sciences (1931–35).

Campbell's astronomical writings will be found for the most part in the publications of the Lick Observatory. His "Elements of Practical Astronomy" (1899) is an unpretentious work, which many students must have found useful. His "Stellar Motions", which was published in 1913, brings together in an attractive form that part of astronomy to which his own researches had made so large and important a contribution.

In addition to numerous academic honours, Campbell received the gold medal of the Royal Astronomical Society in 1906, both the Lalande and the Janssen Medals from the Paris Academy of Sciences, and the Bruce Medal in 1915. As president of the International Union of Astronomy in 1922–25, he presided over the Cambridge meeting of that body. In the same year, 1925, he delivered the Halley Lecture at Oxford.

The opening years of the present century witnessed a notable expansion in the methods and outlook of astronomy. In this development Campbell played an outstanding part. His character was energetic and forceful, and his successful career can be attributed to a perfect harmony between his considerable powers and the researches which the circumstances of the time led him to undertake. An English fellow in the Lick Observatory cannot fail to add a tribute to his unfailing kindness, and the practical help which he was always ready to give. His sense of duty was outstanding. When, after recovering from the serious illness which brought his services to the University of California to an end, he became president of the National Academy of Sciences, he might have looked forward to an honourable period of comparative leisure at Washington. But it was not to be. The condition of national affairs led the Government to appeal to the Academy for help in a great variety of problems. In dealing with these Campbell did not spare himself, with the result that these years of office, so far from bringing dignified ease, were perhaps even more strenuous than any in his busy life. In him has passed away not only a great astronomer whose name will remain in the history of the science, but also one who was no less conspicuous in the public service of his country. H. C. P.

Dr. Alexander Galt

DR. ALEXANDER GALT, whose death at the age of eighty-three years occurred on June 26, was appointed keeper of the Technological Department, the Royal Scottish Museum, Edinburgh, in 1901, the year in which the Department was founded. He graduated at the University of Glasgow where he was a Thomson (Lord Kelvin) scholar in physical science, and a Donaldson scholar in natural science. For eight years he was official assistant to Lord Kelvin in Glasgow University. Among his publications were papers on physics and physical chemistry in the *Proceedings* and *Transactions* of the Royal Societies of London and Edinburgh. He was external Examiner in Experimental Physics for degrees in Arts and Science in the University of Edinburgh in 1910–14.

Soon after the Royal Scottish Museum came under the control of the Scottish Education Department, the new post of keeper of the Department of Technology was offered to Dr. Galt. The inauguration of this Department was really a reversion to the original purpose of the Museum, founded in 1854, under the name of the "Industrial Museum of Scotland". Dr. Galt had no previous experience of museum work, although he had the important qualifications of a large educational experience, a scientific training and a wide and intimate knowledge of science, and its application to industry.

While the work of organizing the Department was one of exceptional difficulty, it offered great opportunities to Dr. Galt's creative abilities. After careful study of the problem it was decided to illustrate, by means of models and specimens, the great industries of general engineering, coal mining, and the manufacture of iron and steel. Other branches of science and industry were added later and the scope of the collections was extended.

Under Dr. Galt's personal supervision many very fine working models of engineering, mining, and other interest were constructed in the Museum workshops, and added to the growing collections, which are to-day of world-wide repute.

Miss Edith Stoney

THE British Federation of University Women has suffered a great loss in the death, on June 25, at the age of sixty-nine years, of Miss Edith Stoney who, on the day of her death, had been elected one of its vice-presidents. Edith Stoney was a member of a distinguished Irish family of scientific workers; her father, an uncle and a brother all being fellows of the Royal Society, whilst her sister, Dr. Florence Stoney, was one of the pioneers of X-ray work in medicine.

Edith herself was a mathematical physicist. As a student of Newnham College in 1890–94 she took

both parts of the Mathematical Tripos, being bracketed equal to the seventeenth wrangler in Part I. She also had charge of the telescope at Newnham. After leaving Cambridge she became head of the Physics Department in the London (Royal Free Hospital) School of Medicine for Women, a post which she resigned in 1915 to take up war work. She joined the Scottish Women's Hospitals and served first in the Tent Hospital at Troyes where she put up and ran the X-ray Department, and afterwards in Serbia, where the unit was ordered by the French authorities. Later she became lecturer in physics at the King's College for Household and Social Science.

Edith Stoney travelled considerably, and a visit to Australia convinced her of the need for visits from Great Britain to the Dominions. She supported these views practically and generously by her gifts to the British Federation of University Women of research studentships in science to enable younger women graduates of the universities of Great Britain and Ireland, who were also members of the Federation, to go to these countries. She was so pleased with the success of her first scholars in Australia and New Zealand that this year she gave a sixth studentship, this time to be held in South Africa, to which the award was made at a meeting attended by Miss Stoney only a week before she died. The subjects of the studentships awarded included biochemistry, zoology (insect parasites) and botany. It is learned that in her will she has left money to the Federation for the continuance of these Johnstone and Florence Stoney Studentships. Her association with the Federation has been a great stimulus and pleasure to her fellow-members, who will be deeply sensible of the loss they have sustained in her death.

Prof. Rudolf Vondráček

BY the death of Prof. R. Vondráček at Brno on June 12, Czechoslovakia has lost a distinguished chemist and technologist. Vondráček began his career as a research worker in pure and applied chemistry whilst completing his studies under Prof. Votoček at Prague, with whom he investigated the separation of certain reducing sugars by hydrazine. Altogether he contributed about fifty original papers to Central European periodicals and he was the author of four text-books.

After a period spent in the laboratories of industrial concerns and during which his researches related mainly to analytical methods, Vondráček spent some time before and during the Great War as an examiner for the Austrian Patent Office in Vienna. In December 1918 he returned to Czechoslovakia to take up the appointment as professor of chemistry at the Brno Polytechnic, a post he held until his death. During this time he was twice dean (1920–21 and 1930–31) and he filled the office of rector during the session 1935–36.

His most important researches are connected with a study of the corrosion of metals and with the chemistry and physics of fuel technology. He made careful investigations into the calorific value of various fuels and directed attention to certain anomalies in fuel analysis such as the variation in the estimated water content, an apparently greater loss being recorded at 100° C. than at 105° C. He noticed, too, a 'time-lag' in the absorption of moisture by coal.

Prof. Vondráček was an authority on the destructive distillation of fuels at low temperature, for the experimental study of which he used a bath of boiling sulphur. He carried out analyses of the gases evolved by the Czechoslovak petroleum springs at Gbely and succeeded in removing carbon monoxide and unsaturated hydrocarbons from the gas, which is used locally for lighting and heating. Even his physico-chemical researches had some bearing upon industrial technology. Thus, almost his last work was a study of the binary systems of phenol with hydrocarbons. He found, among other things, that phenol is a suitable reagent for the separation of hydrocarbon mixtures, being preferable to such means as nitration or bromination.

He was a member of many continental scientific societies and was prominent in the activities of the Masaryk Academy of Work. G. D.

Mr. A. W. Shorter

WE regret to record the death of Mr. A. W. Shorter, assistant keeper in the Department of Egyptian and Assyrian Antiquities of the British Museum (Bloomsbury), which took place on May 31 at the age of thirty-two years.

Alan Wynn Shorter was the son of Mr. Wilfrid Wynn Shorter, and was educated at St. Paul's School and Queen's College, Oxford, where he graduated in 1928. Before taking his degree he had for some time devoted himself to the study of Egyptology, and more especially to the study of the religious beliefs and rituals of the ancient Egyptians, as set forth in "The Book of the Dead". On leaving Oxford in 1928–9 he spent a year working on the excavations of the Egypt Exploration Society at Tell el-Amarna; and on his return to England he secured an appointment on the staff of the British Museum. Here in the Department of Egyptian Antiquities he was able to continue his study of the material culture, arts and religion of the ancient Egyptian people. He was the author of a number of popular books on these subjects, and also contributed to the publications of learned societies, specializing in the study of Egyptian papyri. His principal contribution to Egyptology is a "Catalogue of Egyptian Religious Papyri in the British Museum".

WE regret to announce the following deaths:

Prof. R. M. Bird, professor of organic chemistry in the University of Virginia, on June 4, aged seventy-one years.

Dr. B. T. Galloway, formerly pathologist in the U.S. Bureau of Plant Industry, on June 13, aged seventy-four years.

Sir Colin Mackenzie, formerly director of the Australian Institute of Anatomy, aged sixty-one years.

Mr. H. N. Thompson, C.M.G., lately director of forests, Nigeria, on July 9.

News and Views

R. L. Hobson, C.B.

MR. ROBERT LOCKHART HOBSON, keeper of the Department of Oriental Antiquities and Ethnography of the British Museum (Bloomsbury), will retire on July 20. Mr. Hobson, who was educated at St. John's, Leatherhead, and Trinity College, Cambridge, taking a first class in the Classical Tripos in 1893, joined the staff of the British Museum in 1897, when he was attached to the Department of British and Medieval Antiquities and Ethnography. Specializing in the study of ceramics, his early published work dealt with English pottery and porcelain, but later he directed his attention to the ceramics of the Far East, on which he became one of the first authorities in Great Britain, especially in the broader cultural aspects of the subject. His "Chinese Pottery and Porcelain" (1915) was followed by a number of volumes of both special and general interest, such as "The Wares of the Ming Dynasty" (1923), "The Art of the Chinese Potter" (1923) and "The Later Ceramic Wares of China" (1925); but his most considerable production was his authoritative "Catalogue of the Eumorfopoulos Collection" (1925–28). He was also the author of the official guide to the collections of Far Eastern pottery in the British Museum (1924). Mr. Hobson became deputy keeper of his Department in 1921, and on its reorganization some years later as the Department of Oriental Antiquities and Ethnography, was appointed keeper. He received the honour of C.B. in 1931.

Prof. R. V. Wheeler

PROF. R. V. WHEELER has been awarded the Melchett Medal for the current year of the Institute of Fuel. Prof. Wheeler will give the Melchett Lecture to the Institute at 3.30 p.m. on October 13, in the meeting room of the Institution of Mechanical Engineers, Storey's Gate, London, S.W.1. Non-members of the Institute who desire to be present at this meeting will be welcome. Prof. Wheeler has been for many years professor of fuel technology in the University of Sheffield. He is also the director of the Safety in Mines Research Board Experimental Stations in Sheffield and Buxton. Born in 1883, he was educated at Plymouth College, Plymouth, and Owens College, Manchester. He is a Dalton scholar and fellow of the University of Manchester. He is the author or joint author of many publications dealing with the constitution of coal, blast furnace coke, coal mining problems, scientific and technical papers on coal combustion and flame, besides being joint editor of *Fuel in Science and Practice*.

Pilgrim Trust Lectures

IN the annual report last year of the Royal Society, it was announced that the Pilgrim Trust had agreed to provide 250 guineas a year for six years for an annual lecture to be arranged jointly by the Royal Society and the U.S. National Academy of Sciences, and to be delivered alternately in London and Washington. It is now announced that the first Pilgrim Trust Lecture will be delivered in London on December 8, and the Royal Society has selected Dr. Irving Langmuir, a director of the Research Laboratory of the General Electric Company, Schenectady, as lecturer. The second lecture is to be delivered on April 24 of next year, and the National Academy of Sciences, to which falls the task of selecting an Englishman as lecturer, has chosen Sir William Bragg. As Sir William emphasized in referring to the Lectures in his presidential address to the Royal Society last November, they present a unique opportunity for direct interchange of thought by leading men of science of the two countries, and the selection of Sir William to give the first lecture in the United States is both a well deserved compliment and a gesture signifying approval of the views which he has expressed as to the functions of these lectures.

South African Protectorates and Transfer

A DEPUTATION representing the Committee on Applied Anthropology of the Royal Anthropological Institute has been received by Mr. Malcolm MacDonald, H.M. Secretary of State for the Dominions, in order to discuss the question of the consultation of native opinion with regard to the transfer of the Territories to the Union Government of South Africa. The deputation was introduced by Lord Onslow, who (as reported in *Man* of July) referred to the difficulty experienced by the Joint Select Committee on Closer Union in East Africa in understanding the point of view of native witnesses who appeared before it. A variety of points was discussed. Both Prof. B. Malinowski and Dr. Margaret Read, who have recently visited the territories, were in a position to emphasize the deep interest taken by the native population in this question. The latter indeed said that the subject was a matter of discussion so far north as Nyasaland, while judging from her own consultations of native opinion, she urged that the traditionally recognized channels for ascertaining the opinion of the tribes should be utilized. This matter was also stressed by the Rev. E. W. Smith, who pointed out that as regards the Basuto a recognized organ for the expression of native opinion existed in the National Council, adding that their land was the matter on which they felt most deeply. Another matter of extreme importance which was mentioned by Dr. Margaret Read was the care that should be taken in the interpretation into native language of terms referring to political institutions. Mr. MacDonald assured the deputation that these points would be kept in mind in putting the issue before native opinion.

Protection of the Aborigines of Australia

THE series of three articles by Dr. Donald F. Thomson, reciting his experiences among the aborigines of Arnhem Land, which appeared in *The Times* of July 5–7, will have been followed with close attention by all who desire a wider application of scientific methods in the approach to the problems arising out of the contacts of Western civilization and peoples of backward culture. A preliminary account of Dr. Thomson's work appeared earlier and was noted in NATURE of January 8 (p. 68). Dr. Thomson, as he himself expresses it, was 'loaned' by the University of Melbourne to the Government of the Commonwealth of Australia to visit, establish friendly relations, and make an anthropological survey of the native tribes, who had been responsible for unrest and trouble in Arnhem Land in 1933. His expedition, as is now well known and as he records, was completely successful in getting into touch with tribes reputed unapproachable, and as a result of his investigations lasting over the two years 1935–37, he was able to present to the Federal Government a report in which he, as an anthropologist, suggested certain measures to be taken if this interesting and, in their way, attractive people were to be saved from degradation and extinction. That extinction is their inevitable fate, unless immediate steps for their protection are taken, is patent from Dr. Thomson's alarming discovery that the number of aborigines in these tribes has fallen lower by far than was thought. Further, he was able to point to the grave injury which is being inflicted on the aborigines by well-meaning but mistaken philanthropy. A people who had established an equilibrium in the technique of existence in a country of difficult conditions are abandoning their traditional mode of life to obtain the inadequate benefits of a weekly ration and a few of the cast-off rags of civilization, to their irretrievable detriment.

DR. THOMSON suggests as the immediate need of the situation the complete segregation of the aborigines on an inviolable reserve. The aboriginal reserves are in theory already 'out of bounds' for the white population, but in practice this has not been observed. He is also of the opinion that control of all aborigines should be handed over by the State Governments to the single control of the Federal Government. Dr. Thomson was able recently to explain his suggestions in fuller detail than was possible in *The Times* before the Committee on Applied Anthropology of the Royal Anthropological Institute (as reported in *Man* of July). After analysing the causes of depopulation and alluding to the failure of missionary effort to turn the tribesmen into gardeners, he went on to suggest that the policy of complete segregation should be supplemented by a legal code adapted to native conceptions, the creation of a special native-affairs service staffed by anthropologists, working as mobile patrols, and additional medical service. Further, that the system of segregation should be maintained until a constructive development policy has been worked out for those aborigines who are already detribalized.

An Expedition to North Rona

A SMALL expedition left the Summer Isles by Fishery Cruiser *Vigilant* for North Rona on July 11. Dr. and Mrs. F. Fraser Darling of Tanera expect to spend six months studying the social behaviour and environmental influences on behaviour of the Atlantic or Grey seal, *Halichœrus gryphus*. Dr. Fraser Darling has already published researches on the social life found in the red deer and in several species of birds. His work on the Grey seal began with a four months expedition to the Treshnish Isles in 1937. The gregariousness apparent in these seals is of patriarchal type and entirely different from the matriarchy of the deer herds and the communities of pairs which constitute breeding flocks of birds. Dr. Fraser Darling's expedition is a private venture, but the cost is being defrayed in part by a fellowship from the Carnegie Trust and grants-in-aid from the Royal Society, the British Association, the Institute for the Study of Animal Behaviour and the Challenger Society. The Fishery Board for Scotland has co-operated generously in the all-important matter of transport. North Rona lies fifty miles north-east of the Butt of Lewis and is a rock-bound islet of less than half a square mile in area. The Atlantic seal repairs there to breed in large numbers from September to November, and the island is also one of the few breeding places of that interesting nocturnal bird, Leach's fork-tailed petrel.

Engineers and International Affairs

IN his address to the North East Coast Institution of Engineers and Shipbuilders, when he received the diploma of honorary fellowship of the Institution on June 24, Rear-Admiral G. H. Rock, of the Constructive Branch of the United States Navy, made special reference to the education of engineers and the participation of engineering organizations in international affairs. In educational circles in the United States, there has been an astonishing increase in the interest in such matters. All the leading nations, he said, are exporters and importers of education in its various forms. There are about 8,500 foreign students in the colleges and universities in the United States and an even larger number of American students are studying abroad. In the academic year 1936–37, 204 American professors were either studying or teaching in foreign universities, while at the same time in American colleges and universities there were 175 foreign professors. No professions are more concerned with international activities than those of shipbuilding and ship operation, and he suggested that institutions such as the North-East Coast Institution should lend encouragement to the improvement in the education of naval architects and marine engineers, encourage successful professional men to assist actively in teaching, make more suitable arrangements for ensuring young engineers more reasonable opportunity for employment, and arrange for a more general exchange of students between Great Britain and the United States. Admiral Rock recalled that he received a part of his education in 1890–92 at the University of Glasgow, and he was then sometimes bewildered by

leading articles in the *Glasgow Herald* which criticized the enrolment of foreign students in naval architecture and marine engineering. International co-operation, however, he considers, offers more of gain than of loss, in fact, "gain for all, with loss to none".

The Zeppelin Centenary

By the issue of commemorative stamps, the opening of a museum at Friedrichshafen, and in other ways, Germany has been paying homage to the memory of Count Ferdinand Zeppelin, of airship fame, the centenary of whose birth occurred on July 8. Born on the shores of Lake Constance, Count Zeppelin was educated at Stuttgart, and at twenty years of age became an infantry officer. His military studies led him to visit Italy, France and England, and in 1863 he served with the Union forces in the American Civil War, in the course of his service making a balloon ascent. Returning home, he took part in the war between Prussia and Austria and in the Franco-Prussian War and afterwards rose to high command. In 1891 he retired as a general. He had long conceived the idea of aerial navigation by airship, and free from official duties, and possessing considerable means, he devoted all his energies to the construction of a rigid airship. In 1900 he achieved his first success with *ZI*, a craft 420 ft. long and 38½ ft. in diameter, the envelope of which contained seventeen gasbags with a total capacity of about 400,000 cub. ft. of hydrogen. The two cars suspended beneath the ship had two 18 horse-power Daimler engines. On July 2, 1900, the airship was hauled out of its floating shed on Lake Constance and covered a distance of 3¼ miles before being landed on the water and towed back to the shed. As a military officer, Zeppelin had visualized the use of airships for observations and for carrying dispatches, but their use as a means of transport was his chief aim, and one of his ambitions was to see Europe and America connected by an airship service. This, however, he did not live to see, for he died in Berlin on March 8, 1917, in the midst of the Great War.

Auguste Forel and Alcoholism

In a paper on Auguste Forel and his campaign against alcoholism, read before the Society for the Study of Inebriety and Drug Addiction on July 12, Dr. J. D. Rolleston, after a short sketch of Forel's life, stated that though an active campaign against alcoholism had previously been carried out for many years in Great Britain and the United States, Forel was a pioneer in the scientific anti-alcoholic movement not only in Switzerland, his fatherland, but also on the continent of Europe. The lack of recognition of his work in Great Britain was attributed by Dr. Rolleston to two reasons. In the first place, Forel was strongly opposed to making the campaign against alcoholism inseparable from religion and Christianity in particular, as it is in this country and the United States. The second reason was the severe blow to Anglo-Saxon prudery and obscurantism caused by his classical work on the sexual question. On the other hand, the high appreciation of his work in foreign countries was shown by quotation of the opinions of eminent neurologists, psychiatrists and others in Germany, Hungary, Switzerland and the United States. Forel's contributions to the study of the alcohol problem were then considered under the headings of blastophthoria, alcoholism and the sexual question, exposure of popular errors concerning alcohol, such as the view that beer and wine do not cause alcoholism and the value of alcohol as a food, drug, and indispensable agent in sociability, alcohol and sport, and the treatment of alcoholism.

Inland Water Survey

Definite quantitative results of the Inland Water Survey Committee's investigations are forthcoming in the Surface Water Year-Book of Great Britain 1935–36 (London: His Majesty's Stationery Office, 5*s*. net) which is a statistical report (issued by the Ministry of Health and the Scottish Office) relating to the inland water resources of Great Britain during the twelve months ended September 30, 1936. The publication provides detailed information about the surface water resources of a dozen drainage basins, together with their rainfall. Results for underground water are being published separately in a different form. Twenty-seven rivers, at twenty-eight gauging stations, have been the subject of continuous measurement and the results are tabulated in regard to daily maximum and minimum water levels and daily mean discharge in cusecs. The Year-Book furnishes, moreover, in each case a brief description of the station and the drainage area, together with monthly evaluations of rainfall. The issue of this publication, which is to be continued annually, marks a further stage in the development of the Survey and it will be welcomed by all the various bodies who are interested in the use and application of water whether for agricultural purposes, or for land drainage, fisheries, industries, navigation, sewage disposal or water supplies and the like. Some useful conversion tables are included.

The Norman Lockyer Observatory

The annual report of the Norman Lockyer Observatory, Sidmouth, shows that the activities of the Observatory are well maintained. The 12-in. McClean telescope has been used for taking spectra of ζ Aurigæ during its 1937 eclipse and also of Finsler's comet and of *A*-type stars. Its chief work has been in preparation for colour-temperature observations on early-type stars, and the preliminary experiments have shown that colour-temperature observations may be profitably taken up with this instrument. The 9-in. Kensington telescope has been used on a selected number of bright-line stars, with special attention to γ Cassiopeiæ. Some photographs of star fields have been taken with the Zeiss triplet camera attached to the instrument. Three meteor cameras fixed outside the dome have been used for the photography of meteors, but unfortunately without success up to the present. Prof. Blumbach has used the Mond equatorial for photographs of galactic clusters, Finsler's Comet, and some test plates of the

Andromeda nebula. Two photographs of the aurora of January 25, 1938, were taken by Mr. D. R. Barber, who also contributed notes on its appearance to the local Press. The director, Mr. D. L. Edwards, supplies many other interesting items in his report, dealing with publications, the laboratory, the library, buildings and grounds, etc.

THE Observatory has recently issued the first of a series of bulletins, which will be published from time to time, probably averaging about one a year. These will include articles less technical in character than the usual papers which appear in the *Monthly Notices of the Royal Astronomical Society*, and will describe special lines of research undertaken at the Observatory. In the present number, the first paper, by Mr. D. L. Edwards, deals with the spectra of γ Cassiopeiæ, of which the late Dr. W. J. S. Lockyer gave an account a few years ago. Considerable changes have taken place since, strong absorption lines replacing the early hazy ones, these absorption lines fading out again and new emission lines appearing. The most striking stage was when the absorption lines had completely disappeared and there remained only the spectrum composed entirely of emission lines, the Balmer series of hydrogen being the most prominent feature. Prof. F. I. Blumbach contributes a paper which contains six photographs of Comet Finsler (1937 *f*), taken in August, and this is followed by Mr. D. R. Barber's paper, "Note on the Spectrum of Comet Finsler (1937 *f*)", which describes the objective prism spectrograms of this comet, secured on five favourable occasions in July and August. A useful table is given which supplies a list of the identified emission features of the cometary spectrum, together with their probable origin, wave-length and observed band limits. In the next paper, by Mr. Edwards, there is a description of a tube sensitometer made to a given specification by Messrs. Casella and Co., Ltd., who are also constructing a microphotometer for the Observatory.

Popular Astronomy at Mount Wilson Observatory

RECENTLY, the Carnegie Institution of Washington has catered in a practical way for the immense growth of public interest in astronomical research by opening a special building on Mt. Wilson to be devoted entirely to satisfying the layman's thirst for first-hand information on the many researches undertaken by the staff at Mt. Wilson and other astronomers. For many years, visitors have been privileged on one night per week to use the 60-in. telescope for visual observations of the heavenly bodies, but since the completion of the Angeles Crest highway about two years ago, the number of visitors has become a difficult problem. During 1936, it was estimated that 50,000 persons inspected the 100-in. telescope when it was open to the public, and the total number who visited the Observatory on all occasions during that year reached the large figure of 100,000. The main features of the building are, first, a room for the display of models and photographic transparencies and, second, a lecture-hall, capable of accommodating 270 persons, in which the general public are brought into direct and personal touch with the scientific staff of the Observatory. The Carnegie Institution and the Mt. Wilson astronomers are to be congratulated on their enlightened policy of giving to the public such unique facilities for the practical understanding of what scientific research is accomplishing in the realm of astronomy.

Petrology of Igneous Rocks

WRITING with reference to the review of Hatch and Wells' "Petrology of Igneous Rocks", which appeared in NATURE of May 28, p. 952, Dr. A. K. Wells has directed attention to the second paragraph, which he believes suggests that he has been guilty of plagiarizing the scheme of classification of rocks put forward in the report of a research committee of the British Association. This was not the intention of the reviewer, who states that at no time has he entertained such an idea. He adds that considerations of space precluded mention of the fact, well known to him and to others interested, that Dr. Wells was the moving spirit of the committee in question. The main object of the review was to indicate the radical changes made in the new edition of Hatch and Wells' well-known text-book.

White Fish Commission

THE Minister of Agriculture and Fisheries and the Secretary of State for Scotland have appointed the following to be members of the White Fish Commission constituted under Part I of the Sea Fish Industry Act, 1938: Sir William Palin Elderton (chairman), Mr. H. G. Maurice (vice-chairman), Prof. Alexander Gray, Mr. G. Dallas, Mr. T. Darling. The Commission is charged under the Act with the functions of keeping generally under review matters relating to the white fish industry, and of advising and assisting the Ministers in regard thereto. The Secretary of the Commission is Mr. R. G. R. Wall, to whom all communications should be addressed at the Offices of the Commission, Nos. 6 and 7 Old Palace Yard, Westminster, S.W.1.

Weather Forecasts by Telephone

IN *The Times* of July 11, there is an account of a new enterprise on the part of the Dutch meteorological service and Dutch General Post Office. In Great Britain, anyone can get the latest official weather report over the telephone by asking for it at the Meteorological Office, but on the Hague telephone system the subscriber need only call the number 393131 and he will hear automatically the latest forecast, not only for Holland, but also for Great Britain, Belgium and North and West Germany. To this is added a statement of the distribution of high and low barometric pressure over Western Europe, and doubtless also an indication of the way in which the distribution is changing.

British Empire Cancer Campaign

ON the recommendations of its various committees, the Grand Council of the British Empire Cancer Campaign has made the following grants, totalling

£3,715, which are in addition to the sum of approximately £45,000 already approved in grants for the calendar year 1938: £1,100 to the Radium Beam Therapy Research; £750 for research by Mr. F. C. Pybus at Newcastle; £300 to Dr. P. R. Peacock, at the Glasgow Royal Cancer Hospital, for the salary of a whole-time assistant; £495 for the salary of the physicist at the Strangeways Research Laboratory, Cambridge; £750 for investigations being carried out under the direction of Dr. P. M. F. Bishop and Mr. H. J. B. Atkins, at Guy's Hospital; £270 to Dr. John Bruce, at the University of Edinburgh for part-time investigations, and £50 for a replacement in apparatus at the Strangeways Research Laboratory.

THE re-appointment of Dr. G. Cranston Fairchild as the William Morris Research fellow in radiology at Mount Vernon Hospital has been approved for a further period of three years. This fellowship was created by the Campaign in 1931 at the request of Lord Nuffield, who provided a sum of £25,000 for the purpose of promoting research work and study concerning the treatment and cure of cancer by radiology.

Excavations at Lachish, 1937-38

AN exhibition of antiquities from Lachish, excavated at Tell Duweir, Palestine, by the Wellcome Marston Archæological Research Expedition to the Near East, was opened at the Wellcome Research Institution, 183–193 Euston Road, London, N.W.1, on July 7 and will remain open daily from 11 a.m. until 5 p.m. until July 29. Films of the excavations will be shown daily at 11.30 a.m. and 3 p.m. A lantern lecture on "New Discoveries at Lachish" will be delivered by Mr. C. H. Inge, who has succeeded the late Mr. J. L. Starkey as leader of the expedition, on Tuesday, July 19, at 5.30 p.m.; and on Wednesday, July 27, at 6 p.m., admission being free without ticket.

International Congress for Applied Mechanics

THE fifth International Congress for Applied Mechanics will be held at the Massachusetts Institute of Technology on September 12–16, under the presidency of Prof. Karl T. Compton. At the close of the Congress in Cambridge the members will proceed to Washington, D.C., where a programme of sightseeing and visits to Government laboratories will be arranged by the director of the National Bureau of Standards for September 19. Members will then proceed to Langley Field, Virginia (Old Point Comfort) to spend September 20 at the Langley Memorial Laboratory of the National Advisory Committee for Aeronautics. It is probable that other trips will be arranged for those members from abroad who may desire to visit Pittsburgh, Detroit, Niagara, Schenectady and other cities. The field of applied mechanics will be divided into the following general heads: (1) structures, elasticity, plasticity, fatigue, strength theory, crystal structure; (2) hydro- and aerodynamics, gas dynamics, hydraulics, meteorology, water waves, heat transfer; (3) dynamics of solids, vibration and sound, friction and lubrication, wear and seizure. Further information can be obtained from the Joint Secretaries, Fifth International Congress for Applied Mechanics, Massachusetts Institute of Technology, Cambridge, Massachusetts, U.S.A.

Congress of Anthropology and Ethnology

THE International Congress of Anthropological and Ethnological Sciences, which is being held in Copenhagen on July 31–August 6, promises an interesting programme. While sufficient time is being allowed for giving the various sectional papers, a number of excursions have been arranged. For example, a general meeting of the Congress is to be held in the Great Hall of the Castle of Kronborg, where native Greenlanders will show their skill in kayak paddling, etc. The most important function of these international congresses undoubtedly is to enable *savants* from different countries to meet and talk together; too many sectional papers leave not enough time for this. There are to be the usual number of banquets provided by the various official bodies. After the close of the Congress an excursion has been arranged to visit the various places of historical interest in Denmark. While one cannot expect to be repeated the outstanding generosity of the Rumanian Government, which last year provided *gratis* for the Congress of the International Institute of Anthropology a sleeping-car train for a week to visit all the interesting places in Rumania, the total expenses of a member of the forthcoming Congress in Denmark, when everything is considered, will not be at all excessive.

1851 Exhibition Scholarship Awards

THE Science Scholarships Committee of the Royal Commission for the Exhibition of 1851 announces the following appointments for 1938 for research at the various centres indicated: *Senior Studentships:* Dr. W. E. van Heyningen, biochemistry at the University of Cambridge; Dr. H. Walke, nuclear physics at the University of Liverpool; R. Brown, plant physiology at the Imperial College; Dr. W. A. Deer, petrology at the Universities of Manchester and Cambridge; Dr. R. A. Buckingham, mathematical physics at the Queen's University of Belfast and the Massachusetts Institute of Technology. *Oversea Scholarships:* Canada: Dr. W. M. Smith, physical chemistry at the University of Cambridge; Dr. G. C. Butler, biochemistry at University College Hospital, London; Dr. H. J. Bernstein, physical chemistry at the University of Copenhagen or the California Institute of Technology; D. C. MacPhail, engineering at the University of Cambridge. Australia: A. A. Townsend, physics at the University of Cambridge; A. J. Birch, organic chemistry at the University of Oxford; M. E. Griffiths, endocrinology at McGill University, Montreal. New Zealand: E. F. Daly, physical chemistry at University College, London, or the University of Manchester. India: Dr. R. S. Krishnan, physics at the University of Cambridge; Dr. N. K. Panikkar, zoology at the Marine Biological Laboratory, Plymouth.

Travelling Fellowships in Tuberculosis

THE Medical Research Council announces that Dorothy Temple Cross Research Fellowships have been awarded to the following candidates intending to study problems of tuberculosis at centres abroad, during the academic year 1938–39: N. C. Oswald, chief clinical assistant, Brompton Hospital, London; J. F. Paterson, second assistant, Medical Professorial Unit, St. Bartholomew's Hospital, London; Dr. K. M. A. Perry, medical first assistant and registrar, London Hospital; Dr. J. O. Westwater, formerly assistant medical officer, Glenlomond Sanatorium, Kinross. All these fellows propose to work at centres in the United States.

Record Endurance Flight by Glider

Lieut. W. B. Murray and J. S. Sproule, flying a two-seater Falcon glider, have set up a record for endurance by remaining in the air for 22 hours 13 minutes, from 4.9 a.m. on July 9 until 2.22 a.m. on July 10. The flight was made at the opening of the National Gliding Contests at Dunstable Downs and in difficult weather conditions.

Recent Large Sunspots

PARTICULARS are given to date (July 8) of two recent sunspots, noteworthy on account of size, which places them in the category of naked-eye spots.

Date on Disk	Central Meridian Passage. U.T.	Latitude	Maximum Area
July 3–13	July 7·2	14° N	1000 units
,, 4–17	,, 10·7	13° S.	850 ,,

The unit of area is one millionth of the sun's visible hemisphere. A sunspot of area 500 millionths, not too near the edge of the disk, is usually visible to the naked eye, when the brilliancy of the disk is sufficiently reduced by a dense glass filter.

Addendum (July 12). Another large spot has come over the eastern limb in south latitude 11°, the time of central meridian passage being July 15·1. By July 11, the area of the spot had reached 1,500 units.

Announcements

SIR WILLIAM BRAGG, president of the Royal Society and director of the Royal Institution, has been elected a foreign associate of the Paris Academy of Sciences. The number of foreign associates of the Paris Academy is limited to twelve, and the only other living British man of science in this distinguished company is Sir Joseph Thomson.

SIR ARTHUR OLVER, until recently animal husbandry expert, Imperial Council of Agricultural Research, India, has been appointed Principal of the Royal (Dick) Veterinary College, Edinburgh, in succession to the late Principal Bradley.

THE following have been appointed to fill the vacancies which will occur in the Council of the Institution of Electrical Engineers on September 30: *President:* Dr. A. P. M. Fleming; *Vice-President:* Prof. C. L. Fortescue; *Hon. Treasurer:* Mr. W. McClelland; *Ordinary Members of Council:* Dr. P. Dunsheath; Prof. R. O. Kapp; Mr. A. P. Young; Dr. L. G. Brazier.

DR. EDGAR COCHRANE, of Accra, Gold Coast, has been awarded the North Persian Forces Memorial Medal for 1937 for his paper on tuberculosis in the tropics published in the *Tropical Diseases Bulletin* last year.

THE Howard Prize (an aneroid barometer, given annually for the best essay on a selected meteorological subject) of the Royal Meteorological Society has been awarded to Cadet Colin Derek Thorpe, of H.M.S. *Conway* School Ship. Consolation prizes have been awarded to Cadet Arthur Vernon Baker (H.M.S. *Conway*), Cadet Godfrey Harry Hayes (H.M.S. *Conway*) and Cadet Richard Christopher Stancliffe Hurst (H.M.S. *Worcester*), who were bracketed second. The subject of the essays was "Clouds".

THE following appointments and promotions in the Colonial Service have recently been made: G. E. Boizet, assistant analyst, Malaya; Dr. Campbell, plant pathologist, Zanzibar; G. R. Howat, analytical chemist, Medical Department, Gold Coast; W. A. Tooke, chemist, Geological Survey Department, Malaya; E. J. Gregory (manager of the St. Augustine Experimental Station, Trinidad), agricultural officer, Uganda; M. D. Lumsden (veterinary officer), assistant officer-in-charge, Government Stock Farm, Trinidad.

LIEUT.-COLONEL E. v. WHITBY, of the Royal Army Medical Corps, has been awarded the Leishman Memorial Prize for 1937 consisting of a silver medal and a sum of £30. The prize is awarded annually to an officer of the Royal Army Medical Corps or the Army Dental Corps for work of outstanding merit.

PROF. REYNALDO DOS SANTOS, of Lisbon, has been awarded the Violet Hart gold medal for his work on vascular surgery on the occasion of the recent Surgical Congress of the Southern United States.

PROF. WOLFGANG OSTWALD, professor of colloid chemistry at Leipzig, and Prof. Eric Murtini, professor of medical zoology at Hamburg, have been nominated as honorary members of the Rumanian Academy of Sciences at Bucharest.

THE June issue of the *London Hospital Gazette* is a bicentenary appeal number containing an article on the staff in the past by Dr. Robert Hutchison, consulting physician to the hospital, the growth of the hospital laboratories by the director, Dr. P. N. Panton, nursing at the London Hospital by the matron, and the coming bicentenary of the Hospital and College by Dr. Cecil Wall, senior physician to the hospital.

SIR HOWARD GRUBB, PARSONS AND CO. have taken over the astronomical instrument and observatory equipment business hitherto carried out by Messrs. Cooke, Troughton and Simms, Ltd., of York. The address of Sir Howard Grubb, Parsons and Co. is: Astronomical Instrument Makers, Optical Works, Walker-Gate, Newcastle-on-Tyne, 6.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 118.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Formation of Milk

WE have administered labelled (radioactive) sodium phosphate to goats and investigated to what extent phosphorus present in different compounds extracted from the blood and the milk became labelled. In two cases the goat was killed after the experiment and the phosphorus compounds present in the organs investigated as well. Some of the results obtained are seen in the accompanying table.

Activity per mgm. P in milk. (Activity of plasma inorg. P after 4½ hours taken as 1)			Activity per mgm. phosphatide P extracted from milk and organs, after 4½ hours	
Interval after the start of the experiment	Fraction	Activity per mgm. P	Fraction	Activity per mgm. P
0–2 hr.	Inorg. P	0·68	Milk	0·09
	Casein P	0·54	Plasma	0·02
	Ester P	0·32	Corpuscles	0·01
2–4½ hr.	Inorg. P	1·79	Milk gland	0·13
	Casein P	1·71	Liver	0·09
	Ester P	1·16	Kidney	0·11
4½–6½ hr.	Inorg. P	1·71	Activity per mgm. P of milk ester P accumulated in 0–3 hours	
	Casein P	1·71		
	Ester P	1·34		
23–26 hr.	Inorg. P	0·49	Hydrol. 7 min.	0·76
	Casein P	0·55	Hydrol. 60 min.	0·68
	Ester P	0·49	Remaining fraction	0·34
			Milk inorg. P	1·48

Inorganic phosphorus. The inorganic phosphorus extracted from the milk produced in the first two hours after the subcutaneous injection of the labelled phosphorus, shows considerable radioactivity. Should the milk contain only those inorganic phosphorus atoms which were located in the plasma at some time after the start of the experiment, the specific activity of the milk inorganic phosphorus should be as high as that of the plasma inorganic phosphorus. In making such a comparison, it must be borne in mind that the specific activity of the plasma inorganic phosphorus rapidly decreases with increasing time through interaction of plasma phosphate phosphorus with that of bone and other tissue[1]. No definite conclusion can therefore be drawn from comparing a single value of the specific activity of plasma and milk phosphorus. By following up, however, the change of the specific activity of the plasma inorganic phosphorus and milk inorganic phosphorus with time, we find that it takes 3–4 hours for the milk inorganic phosphorus to be almost entirely composed of individual atoms which had been present in the plasma after the start of the experiment.

In milk produced shortly after the start of the experiment, a large part of the phosphorus atoms present were those which were located in the milk gland when the labelled phosphorus was administered. The replacement of the gland inorganic phosphorus by plasma inorganic phosphorus is thus comparatively slow because of a slow rate of penetration of the phosphate ions through the cell walls. Heavy water, on the other hand, injected simultaneously with the labelled phosphate was already, after a short time, equally distributed between plasma and milk, because of the low resistance water molecules encounter when penetrating through cell walls.

Casein phosphorus. The comparatively high specific activity of the casein phosphorus is only compatible with the assumption that the phosphorus atoms utilized in the synthesis of the casein in the milk gland are drawn from the inorganic phosphorus of the plasma. From the difference in the rates at which the active casein phosphorus and the active inorganic phosphorus present in the milk are formed, the time of formation of the casein in the gland cells can be estimated to be about 1 hour.

Ester phosphorus. The rate of formation in the milk gland of the average labelled phosphorus ester molecule is lower than that of the average casein molecule (cf. table). 1½ hours after the administration of radioactive hexose monophosphate (kindly presented to us by Prof. Parnas) injected into the veins of the goat, an appreciable amount of labelled ester was found in the milk, while another larger part of the activity was found in the inorganic milk phosphate. This result shows that a rapid enzymatic breakdown of the hexose monophosphate and rebuilding of ester molecules takes place in the gland. The milk gland contains thus enzymes having the same action on hexosemonophosphate as Robison and Kray's[2] bone extracts; however, the bulk of the esters present in the milk are acted on by enzymes present in the gland at a much slower rate. Similar behaviour is shown by the mixture of phosphorous esters present in the blood[2].

Phosphatide phosphorus. The formation of active phosphatide molecules is, as seen from the table, a slow process. The individual phosphatide molecules present in the milk were mainly built up in the milk gland and not taken up as such from the plasma (as is the case with the yolk phosphatide[1]). This follows from the fact that the specific activity of the phosphatide phosphorus extracted from the milk gland and also from the milk itself is higher than that secured from the phosphatide of the plasma. The view is often encountered that the milk fat originates from the plasma phosphatides which decompose in the milk gland, supplying fat and inorganic phosphorus. This view is entirely incompatible with the results obtained by us. To mention only one argument, we find the phosphatide phosphorus of the milk to be slightly, the inorganic phosphorus present to be strongly, active. The latter can therefore only originate from the highly active inorganic phosphorus of the plasma.

It is well known that different milk fractions, secured consecutively within a short time, have a markedly different fat content. As we find[2] that the inorganic phosphorus extracted from these fractions has a different specific activity, we have to conclude that these fractions cannot originate from an initially homogeneous liquid. So we arrive at the result that some of the milk gland cells give off milk much more readily than others, but that some even of the first-mentioned cells retain a large part of their solid milk constituents, particularly the phosphatides (and fats). Not only are phosphorus compounds present in the milk not formed during the act of milking, as often assumed, but such compounds contained in the last fraction secured during the act of milking are partly of earlier date than those present in the immediately preceding milk samples.

We wish to thank Profs. Bohr, Brønsted and Lundsgaard for numerous facilities kindly placed at our disposal, Prof. Lawrence for the generous gift of some powerfully active phosphorus preparations and Miss Hilde Levi for carrying out the counting experiments.

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June 15.

[1] Cf. Hahn, L., and Hevesy, G., NATURE, **140**, 1059 (1937).
[2] Cf. Robison, R. "The Significance of Phosphoric Esters in Metabolism" (New York, 1932), 66.
[3] A detailed account of the experimental results obtained will be found in the dissertation of A. H. W. Aten, jun., to be presented to the University of Utrecht.

Concentration and Measurement of Atmospheric Ozone

MORE than ninety years ago, C. F. Schönbein, the discoverer of ozone, claimed its presence in atmospheric air[1]; his 'ozonometer', consisting of paper soaked in potassium iodide and starch, indicated interesting variations in the ozone content of air which were deemed of such importance by meteorologists and medical men that regular observations were started in most civilized countries. We possess daily records of many decades, and the statement that millions of ozone determinations have been carried out[2] is probably not exaggerated.

Unfortunately, these numerous measurements are open to the criticism that the chemical reaction used is not specific, other oxidizing agents having the same effect on potassium iodide; as the presence in air of at least one of them, nitrogen peroxide, is certain, and can amount to the same order of magnitude[3], the value of all these 'quantitative' ozone records is extremely doubtful. Since attempts to identify it by specific reagents were unsuccessful, some chemists were even inclined to deny altogether the presence of ozone in the air.

The direct spectroscopic determination of atmospheric ozone, though possible, is too difficult and costly for routine measurements. We have therefore attempted to make the old chemical method reliable[4], and believe we have achieved this aim by introducing the following refinement: the current of air (at least 500 litres) is not passed directly over (or through) the reagent, but its ozone content is first concentrated by condensation, and then separated from less volatile oxidizing agents, for example, nitrogen peroxide, by fractional distillation. This procedure became possible after we had found that even in very low concentration (about one part in 100 million parts of air) ozone can be condensed on silica gel at liquid air temperature, and re-distilled without loss. If, in the latter process, the temperature is not allowed to rise above −120°, the whole of the nitrogen peroxide is held back, and is itself available for colorimetric tests. (We employed for this purpose the 2-4-xylen-1-ol method[5].) The determination of the purified ozone can be carried out in the usual way[4] in a few minutes by titration with potassium iodide and starch.

It is also possible to collect the re-distilled ozone in a glass tube with quartz windows and to measure its absorption of ultra-violet light. Thus an ozone thickness equal to the ozone in more than 30 kilometres of air can be concentrated in a short tube, no complications arise through the absorption of light by dust particles and Rayleigh scattering, and the calibration can be effected by direct chemical analysis; consequently the spectroscopy of the atmospheric ozone becomes much simpler, and we hope, in collaboration with Prof. H. Dingle, to work it out in a quantitative way.

The photographic records of the characteristic ozone absorption so far obtained show conclusively that the volatile part of the condensate is actually ozone. Another qualitative proof was provided by the use of 'tetramethyl base', a colorimetric reagent less sensitive than the iodine-starch method, but strictly specific[7]; thanks to the preceding concentration, the ozone was sufficient for the application of this method, and these tests, too, were convincing.

The accompanying table gives some of the results obtained. As can be seen, we also determined in each case the nitrogen peroxide content. In most experiments the analysed air was taken in South Kensington outside the laboratory, in a wide street with little traffic (Imperial Institute Road). As it was conceivable that both the ozone and nitrogen peroxide values in a town atmosphere are very different from the average, we thought it advisable to carry out a few parallel experiments at Kew Observatory, which is near the open country.

Date (1938)	Weather		(Per cent by volume) × 10^8 Ozone	Nitrogen peroxide
Feb. 7	Dull and cold		0·8	0·4
„ 8	Dull and overcast		0·5	0·6
„ 10	Raining		0·8	0·1
„ 14	Heavy snowstorm		0·8	<0·05
„ 22	Dull and overcast		1·1	1·2
Mar. 3	Warm and sunny		0·9	1·3
„ 7	Spell of very fine		1·9	<0·05
„ 10	weather, warm and		0·6	<0·05
„ 14	sunny		0·9	<0·05
„ 17	Dull and overcast		1·1	0·5
May 6	Cloudy morning	S. Ken.	2·3	0·2
	sunny afternoon	Kew	2·3	<0·05
„ 10	Bright morning	S. Ken.	1·3	0·5
	cloudy afternoon	Kew	2·2	0·3

The mean value of the London ozone measurements is $1·1 \times 10^{-6}$ vol. per cent. We hope later to apply this method to a systematic determination of the dependence of the ozone content on meteorological factors, geographic position and altitude; perhaps it will be possible also to measure the ozone in the higher atmosphere by the use of aeroplanes.

In conclusion, we wish to thank Prof. H. Dingle heartily for his collaboration on the spectroscopic side, and Dr. F. J. W. Whipple for granting us facilities to work at Kew Observatory.

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June 16.

[1] Schönbein, C. F., *Ann. Phys. und Chem.*, **65**, 69, 161 (1845).
[2] Schön, E., *Ber. deutsch. Chem. Ges.*, **13**, 1503 (1880); Fonrobert, E., "Das Ozon" (Stuttgart, 1916), 25.
[3] See, for example, Francis, A. G., and Parsons, A. T., *The Analyst*, **50**, 262 (1925); Reynolds, W. C., *J. Soc. Chem. Ind., Trans.*, **49**, 168 (1930).
[4] *cf.* Conference on Atmospheric Ozone at Oxford, Sept. 1936 (Supplement to *Quart. J. Roy. Met. Soc.*, **62**, 13, 1936). The trustworthiness of somewhat complicated chemical reactions recently used as a basis for ozone determinations is still uncertain.
[5] McVey, W. C., *J. Assoc. Off. Agric. Chem.*, **18**, 459 (1935).
[6] For the time being we adopted Ladenburg's method. Ladenburg, A., and Quasig, R., *Ber. deutsch. Chem. Ges.*, **34**, 1184 (1901); Treadwell, F. P., and Anneler, E., *Z. anorg. Chem.*, **46**, 86 (1905).
[7] Arnold, C., and Mentzel, C., *Ber. deutsch. Chem. Ges.*, **35**, 1324 (1902).

Luminescence of Solids at Low Temperatures

THE fluorescence of solids has generally been regarded as a comparative rarity confined to a few groups of compounds, of which the sulphides of zinc and calcium, the uranyl salts, and a number of platino-cyanides are amongst the better known. Recent observations at low temperatures suggest that many other compounds are fluorescent, and a fairly wide distribution throughout the periodic table is indicated. Table 1 gives a list of some of the more striking compounds, a number of which are not fluorescent at room temperature. The fluorescence intensity of a few of these compounds is weak even at the temperature of liquid nitrogen; compounds also showing appreciable fluorescence at room temperatures are indicated in italics.

TABLE 1. COMPOUNDS FLUORESCENT AT LOW TEMPERATURES.

Anhydrous beryllium sulphate	Samarium sulphate
Anhydrous magnesium chloride	Silicic acid
Zinc oxide and chloride	Stannous chloride
Zinc sulphate anhydrous	Lead nitrate
Zinc orthosilicate	Lead chloride
Zinc sulphide	*Phosphorus*
Cadmium chloride	Antimony trichloride
Cadmium bromide	Bismuth trichloride
Cadmium iodide	Anhydrous manganous chloride
Mercuric chloride	Anhydrous manganous bromide
Mercurous chloride	Manganous bromide
Cuprous chloride	*$PtCl_2$.dipyridyl red form*
Silver chloride and bromide	$PtCl_2$.dipyridyl yellow form
Indium acetyl acetone	Sodium fluorescein
Samarium sesquioxide	Rhodamine 'G.B. 500'

Detailed comment is not possible here, but it may be remarked that the zinc sulphide mentioned in the table was sufficiently pure to be non-fluorescent at room temperature under a strong focused beam of ultra-violet light. Cuprous chloride is of interest as it gives two different spectra according to the temperature; the effect is conveniently observed as follows. A thin copper strip is coated at one end with a layer of chloride and cooled to approximately 80° K. On quickly removing the strip from the cooling liquid and placing in the ultra-violet beam, a narrow band of red fluorescence moves rapidly along the specimen from the warmer end. As the red fluorescence disappears, it is followed by a much wider band of green fluorescence, the temperature range of this being very roughly −150° C. to −100° C.

It is considered that the fluorescence of some of these compounds is a feature of the pure substance, but it is naturally difficult to be sure of this when very minute traces of impurity may be effective; this aspect of the problem is under investigation. Some of the compounds were extremely pure, and the remainder were of reasonable (analytical reagent) purity. If the fluorescence observed should prove to be that of impurity phosphors, it is clear that the examination at low temperature provides a more sensitive test of purity than the more normal procedure.

Lowering of temperature gives rise in many instances to a marked narrowing of the diffuse emission bands of fluorescent solids. While this narrowing frequently leaves much to be desired, it is sometimes sufficient to indicate features that would not otherwise be observable. In the present instance it has been used to compare the spectra of a number of impurity phosphors all activated by manganese, at temperatures between 20° K. and 85° K. Table 2 summarizes the results.

TABLE 2.
LOW TEMPERATURE SPECTRA OF IMPURITY PHOSPHORS ACTIVATED BY MANGANESE.

Substance	Temp.	Main features of fluorescence emission spectrum	
Zinc orthosilicate	20° K.	4000 A.–5000 A.	Mod. strong continuum
		5035 A.	Sharp edge
		5070	Weak line
		5100	Weak line
		5155	Strong line
		5180	Mod. str. line
		5220	Centre of intense band
		5320	Mod. strong line
		5900–6300	*Weak band*
Zinc sulphide	20° K.	*5940*	*Intense narrow band*
Zinc beryllium silicate	85° K.	4000 A.–5000 A.	Weak continuum
		5300 A.	Mod. strong broad band
		5920 A.	*Strong narrow band*
Cadmium chlorophosphate	85° K.	4000–5000	Mod. continuum
		5950 A.	*Intense narrow band*
Cadmium silicate	85° K.	4000 A.–5000 A.	Mod. strong continuum
		5960 A.	*Mod. strong narrow band*
Cadmium iodide	85° K.	*5900* A.	Broad continuum with peak at approx. this wave-length
	(300° K.)	*6325* A.	*Narrow band*
Silver chloride	85° K.	4725	Strong band
		6210	*Mod. strong narrow band*

In this series zinc orthosilicate is the only substance showing a number of sharp lines in addition to a diffuse background. Comparison of the spectra indicates that all six substances have a band lying between 5900 A. and 6000 A. Allowing for the varying nature of the matrix lattice, it is considered that this band is to be associated with the manganese impurity common to all. If this suggestion is maintained, it follows that the fluorescence of these compounds is at least in part due to transitions within the manganese atom or ion. Some support is given to this idea by the observed fluorescence of pure manganous compounds (Table 1), the two compounds noted each giving a narrow band at 6325 A. approximately. In the case of zinc orthosilicate, where the 'manganese band' is weak, the observed resolved spectrum in the green may also be due to manganese

excited differently because of some difference in the number or distance of nearest neighbouring atoms. It also seems possible, however, that the manganese impurity may have here a different major role: that of stimulating fluorescence in the matrix lattice. If this explanation is the true one, the zinc atoms contributing to the fluorescence would be those nearest to the impurity manganese atoms. The fluorescence of calcium oxide recently reported by Ewles[1] would appear to be of this type.

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June 9.

[1] Ewles, *Proc. Leeds Phil. Soc.*, **3**, 277 and 416 (1937–1938).

Rod-shaped Clay Particles

THE minerals found in clays and soil colloids are usually considered to be plate-shaped and to have layer lattices built up from sheets of silicon – oxygen tetrahedra. This may be true in the majority of cases, but rod- or needle-shaped particles can also occur and should not be overlooked. Their presence may be due to one of the following two reasons.

(1) Layer lattice minerals can under special conditions of growth be developed as rods.

(2) Rod- or needle-shaped minerals may exist, with a structure based on single or double chains of silicon – oxygen tetrahedra, similar to pyroxenes and amphiboles.

An example of (1) was found in the crystals of pyrophyllite from Tres Cerritos, Sierra Nevada, California, which I received through the courtesy of Prof. C. E. Tilley, of the Department of Mineralogy, Cambridge. Pyrophyllite usually occurs in flakes and its structure has been determined by J. W. Gruner[1] from powder photographs as a monoclinic layer lattice with Si-Al-Si layers parallel to (001). The crystals from Tres Cerritos form long, thin rods radiating outwards from the centres of spheres. Sufficiently thin crystals give good X-ray single crystal reflections with a period of 5·1 A. for the needle axis. This corresponds to the [100] direction of Gruner's structure, and also to the chain-length unit (*c*-axis) in amphiboles and pyroxenes. According to their structure and orientation, the pyrophyllite rods have only one perfect cleavage parallel to their elongation. The fact that bentonite suspensions may show negative streaming double refraction was taken by A. v. Buzágh[2] as evidence of the presence of rod-shaped particles. It is now well known that the main constituent of bentonite is the layer lattice mineral montmorillonite.

An example of (2) seems to be the series of clay minerals known as palygorskites, which includes the minerals sepiolite and attapulgite. Sepiolite is the magnesian end-member, and a sample from Ampandandrava, Madagascar, with a period of 5·3 A. in the fibre direction, has been extensively studied by H. Longchambon[3], who came to the conclusion that the whole group had an amphibole-like structure, based on double chains of silicon-oxygen tetrahedra. The experimental evidence is, however, not quite conclusive, and J. de Lapparent, who first described the mineral attapulgite[4] as the main constituent of two fuller's earths, maintains a mica-like structure for the group of palygorskites. The water relationships for sepiolite and attapulgite are similar to those for montmorillonite, but no lattice shrinkage or expansion has been observed; it is, therefore, possible that in these minerals channels of water between rings of Si_4O_{11} chains play the part of the sheets of water in montmorillonite.

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A New Phosphoric Ester Isolated from the Products of Yeast Juice Fermentation

THE fermentation hexosemonophosphate (Robison ester[1]) isolated from the products of fermentation of glucose, mannose, or fructose by yeast juice, consists mainly of an enzymic equilibrium mixture of glucose-, fructose- and mannose-6-phosphates[2,3], but as usually purified by means of the lead and barium salts may also contain traces of trehalosemonophosphate, phosphopyruvic acid, triosephosphate, α-glycerophosphate, etc. A typical specimen of the Robison ester also gives a green colour when heated with orcinol and hydrochloric acid, the amyl alcohol extract showing an absorption band about 670 mμ. This fact indicates the presence of an unknown ester in the mixture, since the reaction is not given by any of the above-mentioned phosphoric esters, and differs from that given by pentoses (in absence of iron) in the position of the absorption band; it was found, however, that an identical reaction is given by the 7-carbon atom sugar mannoketoheptose, isolated from the Avocado pear by La Forge[4].

The isolation of the ester responsible for the colour reaction has been achieved by a preliminary oxidation of the mixed ester with bromine at neutral *p*H, the whole of the aldose esters being removed as insoluble phosphohexonates, followed by fractional crystallization of the brucine salts of the residual sugar-phosphates. The barium salt, prepared from apparently homogeneous brucine salts giving an intense blue colour with orcinol – hydrochloric acid, has $[\alpha]_{5461} + 8°$; the analysis agrees with that of a ketoheptose-phosphate. On hydrolysis with bone phosphatase at neutral *p*H, the ester gives rise to a non-fermentable reducing sugar, giving the colour reactions of a ketoheptose; the properties of the sugar, which has not yet been obtained in a crystalline state, are not identical with those of mannoketoheptose but indicate that it may be a mixture of this sugar with others of a similar type.

In normal hydrochloric acid at 100°, the ester is hydrolysed smoothly with a velocity constant, $k = 4 \times 10^{-3}$, practically identical with that of fructose-6-phosphate; on heating with phenyl hydrazine and glacial acetic acid, a precipitate containing 4 per cent phosphorus was formed, but the product could not be obtained crystalline. These facts suggest that the ester is not a 1-phospho-derivative since the known 1-phospho-sugars are rapidly hydrolysed in acid solution and form phosphorus-free osazones. The ester is formed during

the fermentation, constituting 1–2 per cent of a typical Robison ester, but is not present in the similar monophosphate fraction (Embden ester) prepared from muscle extract.

The mechanism of its formation affords an interesting problem in the enzymic synthesis of carbohydrate during the fermentation of hexoses. Meyerhof, Lohmann and Schuster have demonstrated the enzymic formation of ketosephosphates by the condensation of dihydroxyacetonephosphate with aldehydes in presence of aldolase[5], and this reaction might account for the formation of a 1-phosphoketoheptose. The enzymic transference of the phosphoric acid group to another position might then take place as in the case of the Cori ester, glucose-1-phosphate[6].

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Oxygen Transport with Fully Reduced Arterial Hæmoglobin in the Human Being

IT has been long known that infants, born with a transposition of the pulmonary artery and the aorta, may be living with a very cyanotic appearance. In two cases which lately came under our observation, not a trace of oxygenated hæmoglobin was found in the arterial blood with methods certainly sensitive to one per cent of oxygen saturation, although no further marked symptoms of oxygen want were present. The oxygen consumption of the two patients was not far from normal and, though we are not able to give a complete explanation of the curious conditions, we have found some interesting properties in the blood of one patient we had an opportunity of studying somewhat closely at the age of four months.

The hæmoglobin, as judged by its spreading properties at various hydrogen ion concentrations, its oxygen dissociation curve, its alkaline resistance, its vital decomposition and formation (icterus neonatorum) was normal; the concentration varied between 17 and 20 per cent. There was slight acidosis; the *p*H of the blood was in the normal range.

Whereas the oxygen capacity was calculated from the hæmoglobin percentage to be 27 vol. per cent, the Barcroft manometric technique gave an absorption of 38 vol. per cent of oxygen by the arterial blood. Saturation of this blood by carbon monoxide decreased the uptake of oxygen by the expected 27 vol. per cent, leaving an extra absorption of 9 vol. per cent. The same treatment of samples of normal blood always reduced the oxygen absorption to zero.

So the patient's blood appeared to have, besides its normal oxygen capacity, depending on the presence of reduced hæmoglobin, an extra capacity of 9 vol. per cent; the rate of absorption by this extra capacity was about one fourth of that by the normal capacity at room temperature. The extra capacity was not found in the plasma, but only if corpuscles were present; it was not much influenced by small amounts of cyanide or iodoacetate.

The relation between the normal hæmoglobin and the extra capacity is indicated by the following observation. The superficial venous blood of the patient is found to be 20–25 per cent oxygenated by cutaneous oxygen absorption; if this blood is kept in a closed syringe for 30 min. at 37°, its hæmoglobin is at least 95 per cent reduced. Also, if one mixes equal parts of the patient's fully reduced arterial blood and of normal fully oxygenated blood (having the same hæmoglobin content) the resulting mixture after 2 min. is not 50 per cent but only 35 vol. per cent saturated. Again, if the patient's blood is 30 per cent oxygenated and then kept for 30 min. at 37°, it is nearly reduced, and now its oxygen capacity corresponds to the hæmoglobin content, the extra capacity being saturated now.

We have not been able to detect the biochemical mechanism of this extra capacity, but wish to direct attention to this probably not very rare occurrence of oxygen transport with the arterial blood in the completely reduced state.

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Sugar Content of the Hormones of the Pituitary Anterior Lobe and of the Gonadotropic Hormone from Pregnancy Urine

DURING our investigation of the active principles of the pituitary anterior lobe and of the gonadotropic hormone from pregnancy urine, we established the fact that the gonad-stimulating factors of the anterior lobe and, more particularly, prolan from pregnancy urine, contain considerable quantities of carbohydrate, even when in a highly purified state. This carbohydrate could not be removed, nor its percentage decreased, by treatment with weak alkalis or by prolonged and repeated dialysis. Such properties seem to indicate the presence of glycoproteins in the gonadotropic protein factors. The sugar may be combined with the protein in the form of a polysaccharide. The nature and quantity of the basic carbohydrate was determined by means of the orcine-sulphuric acid reaction. The gonadotropic factors of the pituitary anterior lobe contain 6 per cent (maximum value) of mannose; prolan obtained from pregnancy urine contains 19 per cent (maximum value) of mannose; or possibly of galactose, or of both these hexoses (the preparations have not yet been tested for hexosamine).

The existence of mannose (or galactose) in the gonadotropic substances is not surprising. Sørensen and Haugaard discovered that the sugar-protein complexes generally contained mannose or galactose (or both) and not glucose as previously thought. On the other hand, the large percentage of carbohydrate, in comparison with the other saccharoferous proteins, is very noteworthy. It is possible that the physiological activity of the gonadotropic factors is due to, or connected with, the presence of such glycoproteins. The rather remarkable observation was made that, on isolating the gonadotropically active portions of the pituitary anterior lobe, and of pregnancy urine, the sugar content increased. The difficultly soluble portion of the anterior pituitary extract shows no, or only a weak, sugar reaction, the prolactin fraction being practically free from sugar.

It should be mentioned that extracts of the pituitary gland and of pregnancy urine contain, in addition to the sugar present in combination with protein, comparatively large quantities of sugar in the uncombined state, and thus separable by dialysis. This sugar is very probably utilized in the synthesis of the hormone.

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Limited and Unlimited Swelling of High Molecular Substances

THE material available at present allows the establishment of a hypothesis for the mechanism of the transition limited → unlimited swelling (that is, dissolution) of high molecular compounds. On one hand, Brønsted[1] and Schulz[2] have discussed the distribution of molecules of great size over several phases; on the other hand, Hofmann, Frenzel and Csalan[3] and Katz[4] have investigated the one-dimensional swelling of 'graphitic acid'.

The swelling of high molecular substances consisting of chain molecules, however, is more complicated, since they may swell in two dimensions. For the purpose of establishing a simple model, the following assumptions may be made: (1) The solid body consists of a number of long-chain molecules of identical structure and length. (2) The lattice energy has a constant value for all molecules. (3) The sorbing activity of a group is independent of its place within the chain; the number of swelling agent molecules participating in the formation of the coating is proportional to the chain length. (4) Chain molecules of different degree of solvation are miscible. The probability, however, that the swelling agent molecules are distributed unequally over the chains dwindles in the case of long chains, and becomes zero for 'chains of infinite length' as shown by the following consideration.

The total amount of swelling agent taken up, Σ_n, is given by an isotherm

$$\Sigma_n = f(p), \qquad (1)$$

where p is the swelling agent pressure. The transformation gel (solvation degree Σ_n) → gel (solvation degree $\Sigma_{n+\Delta n}$) takes place, if

$$\Delta F_{\Sigma n} = \Delta H_{\Sigma n} - T\,\Delta S_{\Sigma n} < 0, \qquad (2)$$

where ΔF, ΔH and ΔS are the molar changes of free energy, energy and entropy; Δf, Δh and Δs are the corresponding quantities for one mole of the monomer; π is the polymerization degree. In consequence of assumption (3), the heat of swelling, to a first approximation, is given by

$$\Delta H = \pi\,\Delta h. \qquad (3)$$

ΔS is different from zero, as found by Fricke and Lüke[5], and Stamm and Loughborough[6]; Katz[7] suggested that the entropy change is mainly due to an orientation of the sorbed molecules. Therefore, it may be written

$$\Delta S = \pi\,\Delta s. \qquad (4)$$

Accordingly, the ratio $C_n/C_{n+\Delta n}$ of Σ_n-molecules and $\Sigma_{n+\Delta n}$-molecules within the gel is given by

$$\frac{C_n}{C_{n+\Delta n}} = e^{\frac{\pi}{R}\left(\frac{\Delta h}{T} - \Delta s\right)} \qquad (5)$$

When the numerical value of π is considerable, uniform swelling takes place. The swelling is limited, until an amount of swelling agent $\Sigma_{crit.}$ is taken up sufficient to saturate completely the forces acting between neighbouring chains. If

$$\Delta f_{\Sigma crit.} < 0, \qquad (6)$$

dissolution (unlimited swelling) is effected. This condition is fulfilled, if

$$\Delta h_{\Sigma crit.} - T\,\Delta s'_{\Sigma crit.} < RT \ln \frac{p}{kRT}, \qquad (7)$$

where $\Delta s'$ is the solvation entropy change, p the pressure, and k a constant. The upper limit of p is given by the saturation pressure of the swelling agent. Starting from equation (7), it will be possible to estimate the numerical value of $\Delta f_{\Sigma crit.}$ in different systems.

A substance, capable only of limited swelling at ordinary conditions, may dissolve, when the saturation pressure of the swelling agent is increased, for example, agar. The interaction of the polar agar molecules is comparatively strong. In other cases, the interaction may be still stronger, so that complete separation cannot be effected; for example, in the cases of vulcanized rubber, and of Staudinger's[8] "insoluble polystyrene".

Intermicellar swelling is possible on the basis of a secondary structure. This process is more complicated, but essentially not different from that of intramicellar swelling.

The above assumptions and the numerical values will be discussed in detail elsewhere.

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A Simple X-Ray Dosimeter

ALTHOUGH the direct current generated by a photo-electric cell exposed to short wave radiation, extending from the region of the *Grenz Strahlen* to the gamma rays, is only of the order of one hundredth of that induced by visible light[1], it can be used as an accurate measurement of the radiation value. In this Institute, it has for some time been used as a routine method of calibration of the dosage (in r. units) applied to *Drosophila* cultures.

The apparatus is extremely simple, consisting of a Weston photo-electric cell, shielded from visible light by a wrapping of black (photographic) paper, connected by ordinary flexible leads (which need not be shielded and can be of any reasonable length) to a d'Arsonval mirror galvanometer, reading to 10^{-8} amp., and the usual illuminating system. The galvanometer gives a deflection of 300 mm. at one metre for a current of 1 microamp.; this is very nearly the current produced by the Weston cell when exposed to an intensity of 300 r. per minute. The readings are linear between limits of 20 r. and 300 r., with voltages of 40–120 kv. applied to the tube. The cell is usually placed at distances of 12–25 cm. from the target, and at the same level as the irradiated

material. If a distance of more than 25 cm. is employed, it is advisable to connect two or four cells in parallel: the effect is approximately proportional to the number, but it may be necessary to select cells which match each other's characteristics. In general, the cells are very equal in their output, and a comparison of cells five years old with cells one year old showed no significant difference.

In cases where high intensities and short distances are used, the galvanometer may be replaced by a direct reading microammeter. For example, using four cells in parallel at 12 cm. from the target, with an output estimated at 1,000 r., the reading was 12 microamperes: with a single cell it was slightly more than 3.

Such an arrangement has several advantages: it is compact and portable, it is not affected by atmospheric conditions, gives a continuous reading which immediately responds to fluctuations of the radiation produced by voltage changes or thermal variations in the tube. The cell can usually be placed in contact with the object radiated, and once calibrated, by means of a dosimeter or a biological test, can be relied on to give reproducible results. It can be recommended to all who require a rapid and simple method of X-ray dosage.

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Cytology of Metamorphosis in the Culicinæ

C. R. RIBBANDS[1], commenting on my recent communication[2], states that I apparently overlooked the work of Holt[3] on the gut of *Culex*. References to Holt's work may be found in two of my papers[4], which appeared in well-known journals during the past two years. Having been a student of Prof. Metz, I am also familiar with his work on the paired association of somatic chromosomes. Indeed the present investigation was undertaken at the suggestion of Prof. Metz and much of the work was done under his supervision.

Regarding the several points of disagreement between Holt's results and mine, it may be noted that the evidence for my results has been given briefly in four preliminary reports, referred to in this[4] and a former communication[5], and that a detailed account with photomicrographs is in the current issue of the "Contributions to Embryology" of the Carnegie Institution of Washington.

A possible explanation of our different results may be found in the technical advances of the past twenty years. Holt's work was based entirely on sectioned material. The iliac epithelium of *Culex* has the form of a narrow tube, the wall of which is a single layer of cells. These cells are usually in the shape of a flattened ellipsoid. The tube itself is not straight and different regions may be in different states of contraction and expansion. Judging cell size from sections of an organ of this type is very difficult, if at all possible. Camera drawings of such sections yield no certainty regarding cell size. Yet a few such camera drawings by Miss Holt are taken by Ribbands as showing conclusively the lack of correlation between cell size and chromosome number.

In addition to sections and aceto-carmine smears, my best evidence for a correlation between cell size and chromosome number came from whole mounts of the larval hind-gut, dissected out and stained by the Feulgen technique. Whole mounts prepared in this way are invaluable in the study of metamorphosis. All the cells are present whole, essentially undistorted and in their normal position. The preparation is transparent and the upper and lower walls can be examined under the oil immersion. In a series of such preparations, relative cell size is apparent, and the fate of each tissue during metamorphosis can be clearly followed.

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I REGRET that I wrongly concluded[1] that Prof. C. A. Berger had overlooked the work of Holt[2], but no reference to it appears either in his original letter[3] or in either of the other two preliminary accounts referred to therein in which he outlined his results, some identical with those of Holt, others in contradiction to them. His communications contained no mention of his own technique, which therefore could not be compared with that of Holt.

If chromosome number is correlated with cell size in this instance, another example is added to a long list of similar cases[4], but examples of lack of correlation are still known[4]. Berger's data relative to cell size have not been published, but he states that in the ileum of *Culex pipiens* the smallest cells, without complexes, have a nuclear diameter of 3μ, and that "greatest diameters of nuclei range from 10μ to 17μ"[5], these latter cells having complexes of up to 192 chromosomes[3]. Holt illustrated a prophase nucleus (Plate 2, Fig. 19) containing only 18 chromosomes, which had a greatest diameter of about 13μ. Since Holt's drawings are from sections, it is unlikely that the nucleus has been artificially flattened, as it could be when using either smears or the new method which Berger describes above, and therefore this one example indicates that there is no exact correlation between chromosome number and nuclear volume in this tissue. Cell volume is even less likely to be proportional to chromosome number, since instances are known in which chromosome volume affects nuclear volume without altering cell volume[6].

None of the six preliminary reports of Berger give any proof of his more important disagreement with Holt's results, concerning the possibility of a regular reduction in the chromosome numbers in these cells, so I await his detailed account in the hope of a solution both of this problem and of the one concerning correlation between cell size and chromosome number.

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A Triploid Asynaptic *Allium amplectens* from California

TRIPLOID forms of the Californian species *Allium amplectens* Torr. ($2n=21$) are characterized by almost absolute lack of chiasmata at meiosis. In some slides no chiasmata at all occur, in other slides there may be found 1 chiasma in about 500 pollen mother-cells.

The pachytene chromosomes are paired in the manner normal for triploid species and no structural differences between homologous chromosomes are observed. Homologous chromosomes are held together during diplotene exclusively by the relational coiling.

The 21 univalents present at the first metaphase are arranged in an equatorial plate. Their centromeres remain undivided and all the chromosomes are included in one interkinese nucleus.

The second division takes place regularly and leads to the formation of pollen dyads. Almost all the pollen grains investigated exhibit 21 chromosomes, showing the regularity in function of this meiotic abnormality.

Tetraploid forms, collected at the same locality as the triploids, have normal chiasma conditions, and their meiosis runs a regular course. The pollen grains are formed in tetrads and contain $\pm$ 14 chromosomes.

The asynapsis of *Allium amplectens* is evidently genetically caused, and is not due to failure of pairing. It is of a more extreme type than the asynapsis earlier reported from *Zea*[1] and *Crepis*[2].

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Effects of Injury on the Teeth of *Selachii*

IN 1784 Andre[1] attempted to prove "succession" of teeth in cartilaginous fishes, illustrating his paper by a picture of a vertical row of divided teeth at the site of a spine embedded in the jaw of *Galeocerdo*. He contended that the abnormal teeth had developed subsequent to the injury.

Last year, Dr. E. W. Gudger[2] reported similar splitting of teeth and one in which five corresponding teeth had been severed where they overlap those of adjacent rows in *Caracharhinus limbatus*. He also attributed the abnormality to disturbances in the tooth germ.

When considered together, the two halves of the split teeth correspond in every particular to normal teeth, except that the edges may have been smoothed off subsequent to the injuries received.

Whilst extracting individual teeth from the jaws of *Caracharhinus*, I have sometimes caused identical splitting of teeth, usually in the centre but sometimes at the side, but always in the same vertical row of teeth.

Careful consideration of the available literature fails to reveal evidence of teeth in the jaw of sharks having been formed subsequent to an injury or constant forward movement of a revolving gum.

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Points from Foregoing Letters

Prof. G. Hevesy and A. H. W. Aten have administered radioactive sodium phosphate to goats and determined the amount of 'labelled' phosphorus found in blood and in milk, after varying periods. It takes 3–4 hours for the milk inorganic phosphorus to be almost entirely composed of individual atoms present in the blood plasma after the start of the experiment. Casein is apparently formed in the gland cells in about an hour, while it takes rather longer for the formation of the esterified phosphorus and longest to form the phosphatide molecules.

Prof. F. A. Paneth and J. L. Edgar describe a method for the concentration of atmospheric ozone by condensation and fractional distillation. The ozone was thereby separated from nitrogen peroxide and could be identified spectroscopically and determined chemically. The ozone content of London air was found to vary considerably; its mean value was $1{\cdot}1 \times 10^{-4}$ vol. per cent.

A table of thirty compounds which fluoresce at low temperatures (80° K.) and some of them at room temperature is given by Dr. J. T. Randall. The fluorescence in most cases is apparently that of the 'pure' compound. A number of substances (ZnS, AgCl, etc.) activated by manganese showed a common band between 5900 A. and 6000 A.

Dr. G. Nagelschmidt finds that crystals of pyrophyllite from California form long thin rods radiating outwards from the centres of spheres, and directs attention to the possible presence of rod-shaped particles in other clays.

Sugars containing 7 atoms of carbon in the molecule (similar to the mannoketoheptose isolated from the Avocado pear) have been detected by Prof. R. Robison, M. G. Macfarlane and A. Tazelaar in Robison's ester (phosphate ester from the products of fermentation of glucose).

The arterial blood of a child four months old with transposition of the large vessels was found by Dr. R. Brinkman and J. H. P. Jonxis to be completely reduced. Its capacity for oxygen absorption was 1·3 times as large as the value calculated from the hæmoglobin content. This was due to an extra capacity, interacting with the hæmoglobin system.

Dr. Max Hartmann and Fritz Benz find that the gonadotropic hormone of the pituitary anterior lobe and the gonadotropic hormone from urine contain a considerable quantity of sugar, the former 6 per cent of mannose and the latter 19 per cent. Prolactin and thyrotropic hormone contain only a small amount of mannose. It is possible that the sugar-content is an essential factor for the activity of this hormone.

The transition limited → unlimited swelling of long-chain molecules is discussed by Dr. E. Broda. He points out that the entropy change connected with swelling may be proportional to the chain length. The transition occurs discontinuously at a certain activity of the swelling agent. The transition point may be calculated from thermodynamical data concerning the solvation properties of the different groups.

Research Items

Social Symbiosis in Nigeria

An attempt to adapt the well-established biological concept of symbiosis in social anthropology is made by Mr. S. F. Nadel (*Man*, June 1938) to define a new, that is, not yet formulated, and specific category of social organization. It applies to 'development', not in any abstract theoretical sense, but as relating to concrete observable social processes, namely, the reorientation of a social system under certain conditions of external change and pressure. The facts examined concern the Nupe town of Kutigi in Northern Nigeria, in which, in a population of approximately 3,000, the development studied reaches back to events of some two hundred years ago. The population embraces four different tribal sections, originally distinct separate cultural groups, which have migrated into their present domicile in different periods. The way in which these groups reacted and adjusted themselves to each other, and eventually evolved a *modus vivendi*, represents the phenomenon it is proposed to call social symbiosis. Of the four groups two are of Nupe origin, one came from Bornu as wealthy traders and attained political and economic ascendancy, and the fourth consists of freed slaves, Yorubas imported to instruct the Nupe in weaving and dyeing. In the arrangement of the town, which is typically Nupe, locality and tribal section, living-place and migrational stratum, coincide. But between the separate localities and migration strata there exists to-day the closest co-operation, which is the fruit of a far-reaching adjustment. The bonds of contact and common interest gain the significance of a specific and new social factor in the sphere of religion and kinship organization. The three activities of the sections—economic, religious, and social—can be shown to represent a reciprocity and interdependence linking section with section in the framework of a larger embracing social group-unit, that is, a symbiosis, which represents the possible origin of clanship, and is one of the three possible developments in attaining a social equilibrium between diverse cultural groups—co-operation, symbiosis, and complete fusion.

Man of the Old Stone Age in America

Prof. E. B. Renaud, of Denver University, whose explorations in search of archæological sites in Colorado and the neighbouring States have contributed largely to knowledge of the stone age cultures of the south-western United States, devotes his tenth report of "The Archæological Survey of the High Western Plains", sponsored by his University, to a study of the "Black's Fork Culture" of south-west Wyoming. This culture, which consists of series of stone implements of palæolithic type, or rather types, was first recorded so long ago as 1931. The difference in form, patination and appearance of age of these implements from the more usual type of stone implement of the area naturally attracted considerable attention, and its comparison with European palæolithic implements of a similar character provoked no little criticism. Further explorations in 1935 and 1936 increased the number of sites on which these implements occur to sixty-nine, situated in an area extending from Utah on the west to long. 109° on the east and lat. 43° on the north to the Utah line on the south. This area is drained by the Green River and its tributaries, of which Black's Fork is the most important, and apparently the focal centre of the culture. Hence the name. In all, some four thousand specimens have been collected, besides collections in other hands. The 'camp' sites, on which the implements are found, bear a general resemblance to one another. As a rule two cultures are present, an older and a recent; but the two are quite distinct, the older being associated with an older floor of occupation. The materials used are chert, moss agate and quartzite, the specimens falling into six classes, of which three belong to the chert group. Classified on broad lines, the implements are bifaces and unifaces—coup-de-poing, choppers, end scrapers, side scrapers, pointes, and blades. They belong to the early and middle palæolithic—pre-Chellean, Chellean, Acheulean, and Mousterian as well as Clactonian flakes. There is also a pebble industry, which is comparable with the rough quartzite pebble industry of the Upper Garonne. This terminology is used by Prof. Renaud descriptively only, and carries no implication as to age, though his own comparisons and the verdict of a number of distinguished European archæologists concur in seeing in these implements a close resemblance to the African races.

Measurement of Temperamental and Personality Qualities

Report No. 83 of the Industrial Health Research Board, by P. E. Vernon, is an account of the various tests that have been used to measure temperamental and personality qualities by means of rating scales and questionnaires, oral and written, but excluding the ordinary interview and clinical techniques. There is a short description of practically every published test within these limits, with an account of the method adopted, the statistical or other techniques used to evaluate the results, and a critical survey of the results and criteria. That a survey is necessary is implied by the surprisingly large number of the questionnaires in use, and by the fact that both in the medical and industrial field temperamental or emotional problems are proving to be urgent. Efficiency and even happiness in many walks of life are partly bound up with the temperamental make-up of the individual, and some objective measure by which this could be assessed would be of great value. The conclusion of this painstaking study, however, does not permit of any belief that this, at least by the means studied, is an immediate possibility. The author suggests that more care should be taken in compiling the tests and that investigators should not neglect the work of their predecessors. He gives a very clear discussion of the possibilities and drawbacks of this very popular verbal test.

Serological Reactions in Cancer Diagnosis

The polarographic method developed by Prof. Heyrovský depends on the potential set up in a cell between a polarizable dropping mercury electrode and a non-polarizable reference electrode. The literature of the method and of its numerous applications is detailed in a comprehensive bibliography (Bibliography

of Publications dealing with the "Polarographic Method" by J. Heyrovský and J. Klumpar. *Coll. Czechoslovak Chem. Comm.*, **10**, No. 2–3, pp. 23; 1938), which covers the period 1922–37. Dr. Brdička has applied this method to serological reactions, with special reference to cancer diagnosis ("Serologische Untersuchungen mit Hilfe der Polarographischen Methode, und ihre Bedeutung für die Krebsdiagnostik" by R. Brdička, *Acta Internat. Verein. für Krebsbekämpfung*, **3**, 13–30; 1938). Purr and Russel, and Waldschmidt-Leitz, have produced evidence tending to show that in the blood of cancer patients there are relatively less sulphydryl groups than in normal blood. The potential set up at the dropping mercury cathode, being a function of the reducing systems present, may be used to detect the amount of these groups in very small quantities of serum. With this method, the author has investigated sera from 187 normal and pathological subjects, including cancer patients. The cancer sera gave a diminished polarographic reaction, but this was also found in numerous inflammatory conditions, and is therefore not specific for cancer.

Localized Nature of Photoperiodic Response

DR. W. F. LOEHWING has recently published (*Proc. Soc. Exp. Biol. and Med.*, **37**, 631; 1938), the results of experiments in which the bases and tops of soybean plants were submitted to different photoperiods by training them to grow through a slit in a vertical opaque panel. The plants were divided into three groups: (1) controls with leaves and flowers intact, in one set of which tops were given long day and bases short day; in the opposite set tops were given short day and bases long day; (2) tops defoliated and bases exflorated, criss-crossed as in controls; (3) tops exflorated and bases defoliated, criss-crossed as in controls. The responses to differential lighting are clear cut. Dr. Loehwing concludes that the data indicate that the flowering stimulus is a foliar influence entirely distinct from carbohydrate synthesis. The formative floral organization apparently depends upon one or more specific inductors the production of which in the soybean results from short-day illumination. Both the flowering stimulus of short-day and its inhibition in long-day exhibited a direct quantitative relationship to the amount of foliage. The largest number of flowers on defoliated parts appeared on those plants with the greatest number of leaves under short-day illumination.

Protein Synthesis in Detached Leaves

IN an extensive series of experiments on detached leaves of daffodils, *Pelargonium zonale*, *Iris Pseudacorus*, *Tropæolum majus*, *Ligustrum vulgare*, *Helianthus perennis* and *Vicia Faba*, W. H. Pearsall and M. C. Billimoria have shown, by floating the leaves on nutrient solution which allowed of rapid protein synthesis, that the capacity of leaves for protein synthesis under experimental conditions may depend upon their age, protein content and certain factors associated with the physiological condition of the whole plant (*Ann. Bot.*, New Series, **2**, No. 6, 317; April 1938). It is also suggested that the permeability of the dissolved solutes in the experimental medium may be an important factor. The main significance in the results obtained is that it is probably undesirable to attempt to apply to other genera conclusions based on any one type of plant.

Control of Michaelmas Daisy Wilt

MR. N. C. PRESTON has recently tested a method of control, originally suggested by W. J. Dowson, for the Verticillium wilt of the Michaelmas daisy (*Gard. Chron.*, May 14, 1938). The disease is caused by the fungus *Verticillium Vilmorinii*, which apparently does not extend into the smaller top shoots of an infected plant. These can be struck as cuttings, and usually grow into disease-free plants. The malady appears to be rather widely distributed, and it is not always possible to obtain clean stocks for nursery propagation; hence the value of top cuttings as a practical means of multiplication of valuable strains, even though they be infected with the wilt fungus.

Nature of Ultra-virus and Bacteriophage

A USEFUL review of present-day hypotheses about the nature of bacteriophage and ultra-viruses is contained in a recent paper by Prof. C. Levaditi ("Les Ultravirus", *Bull. Soc. d'Encour. pour l'Indus. nationale*, 27–42, Janv.–Févr. 1938). Prof. Levaditi is scientific director of the Alfred Fournier Institute, and is in a good position to review the subject widely. After considering the physiological similarity between bacteriophage and virus, he sifts the evidence for various theories as to their nature. Are they inorganic, or unorganized organic matter comparable to enzymes: are they organized living cells in the full sense of the term, or do they represent life laid down with illiberal autonomy? Prof. Levaditi inclines to the last-mentioned view . . . "les ultravirus et les bactériophages paraissent appartenir a un monde vivant ignoré jusqu'à ce jour". The considerations are mainly illustrated by animal viruses, though plant viruses are also mentioned. A good deal of modern knowledge is collected in the paper, and many interesting questions for future research arise from its perusal.

Segregation in a Species-Hybrid

BY pollinating *Tragopogon pratensis minor* with pollen from *T. porrifolius*, a hybrid was obtained by Dr. O. Winge (*C.R.* Lab. Carlsberg, Sér. Physiol., **22**, No. 9) between two well-known Linnæan species, one of which has yellow and the other violet flowers. This cross was originally made by Linnæus himself and grown in 1759. The species also differ markedly in size of flower heads, foliage characters, size of plant, achenes and pappus. Both are found to have six pairs of chromosomes, but *T. pratensis* has one pair of satellites while *T. porrifolius* has two. There are also differences in the size and constrictions of certain chromosomes. The F_1 shows hybrid vigour but is highly sterile, producing only 8 per cent of good achenes in comparison with the parents. Yet meiosis is regular. Later generations were grown to F_7 and were much more fertile. The F_1 were nearly uniform and intermediate between the parents. Five independent pairs of segregating genes for flower-colour were identified, but the ratios were frequently modified. By selection in later generations, both parental species were obtained, with the corresponding chromosome morphology. It is concluded that all the specific differences arose as genic differences in the chromosomes, and that there is therefore no absolute boundary between species-factors and variety-factors. Two fine coloured plates illustrate the colours and other characters of the heads in the parent species and the various segregates.

Tilting of the Ground at Wellington

In September 1930, an Ishimoto tiltmeter was installed at the Dominion Observatory, Wellington, in the hope that its records might lead to the prediction of local earthquakes. The instrument continued in action until March 5, 1934, when it was broken by the severe earthquake of that day. An account of the results obtained with its aid has now been published by Mr. R. C. Hayes (*Dom. Obs. Bull.*, No. 133, 625–628; 1938). The records showed marked diurnal and seasonal variations. The diurnal tilt, sometimes exceeding 2 seconds, follows the temperature variation, the curves of mean hourly tilt and earth-temperature at a depth of one foot corresponding very closely. The most interesting movement is a persistent westerly tilt of at least 10 seconds in less than $3\frac{1}{2}$ years, perhaps connected with crust displacements preceding the earthquake of 1934. With this possible exception, no connexion has been traced between the tilting of the ground and the occurrence of local earthquakes.

Ultrasonic Dispersion

The technique used by Mr. B. V. Raghavendra Rao, of Bangalore, in obtaining the preliminary results described in NATURE, (139, 885; 1937) is given in full in a recent paper (*Proc. Indian Acad. Sci.*, 7, Pt. 3). The source of light was a cathode cooled, low density, mercury lamp, wave-lengths 4046, 4078 and 4358 being used, 4078 in general proving most suited in spite of its low intensity. The dust-free liquids investigated were contained in a Wood tube and the fine structure of the radiation scattered backwards was examined by means of a Fabry-Perot étalon, the distance piece of which was chosen to suit each liquid. For carbon tetrachloride using a 5 mm. gap étalon, the author finds that while the velocity of ultrasonic waves of 1–1,000 megacycles per second is 920 m. per sec., that of hypersonic waves of more than 1,000 megacycles is 1,070 m. per sec. For acetone on the other hand, using a 4·5 mm. gap étalon, the ultrasonic velocity is 1,205 and the hypersonic 978 m. per sec. For benzene and toluene, measurements of hypersonic velocities have not proved accurate enough to warrant publication.

Elements 43 and 61

A discussion of the possibility of the existence of stable nuclei of atomic numbers 43 and 61 is given by H. Jensen (*Naturwiss.*, 26, 381; 1938). The importance of Mattauch's rule which states that if two isobares differ in nuclear charge by unity one of them must be unstable is emphasized, and it is pointed out that the elements adjacent to element 61, ^{60}Nd and ^{62}Sm, have many isotopes. This points to the fact that a nucleus with atomic number 61 would be unstable, and the same applies to element 43. The possibility that β-active isotopes with these atomic numbers might exist and have very long lives, cannot be entirely ruled out, but is unlikely. The existence of anomalies in the structure of certain nuclei is also mentioned. Considering nuclei with odd mass numbers and only one isobare, the passage from one of these to the next is always accomplished (with four exceptions) by the taking up of either one neutron and one proton, or two neutrons, so that the atomic number only increases by 1 at the most. Hence every chemical element must have at least one odd isotope. The exceptions are the mass numbers 37 (Z = 17), 97 (Z = 42), 139 (Z = 57) and 145 (Z = 60). In these cases transition to the next nucleus of odd mass number is accomplished by taking up two protons, so that the nuclei of atomic numbers 18, 43, 58 and 61 are passed over. Nuclei with atomic numbers 18 and 58 do, however, exist with even mass numbers. On the other hand, the remaining two, having odd atomic numbers (43 and 61) can have no isotope with an even mass number (owing to the rule that heavier nuclei with even mass numbers have always an even atomic number), and so should not exist at all.

Polyphenol Oxidase

Keilin and Mann have recently described the preparation from *Psalliota campestris* of a highly purified polyphenol oxidase (*Proc. Roy. Soc.*, B, 125, 187; 1938). The enzyme contains copper as an essential constituent of its active group. The less pure preparations contain large amounts of copper, which, however, does not belong to the enzyme, and no proportionality is found between copper content and activity until the copper is between 3·2 γ and 3·5 γ per enzyme unit. At this level, the copper content and the enzymatic activity are strictly proportional. The enzyme in its pure form has a high specificity. Even when crude, it oxidizes ortho-dihydroxyphenols with great rapidity, but affects only a few monophenols, such as *p*-cresol. As it is purified, the enzyme gradually loses its power of catalysing the oxidation of monophenols.

Constant of Nutation

Dr. H. Spencer Jones has recently published a paper (*Mon. Not. Roy. Astro. Soc.*, 98, 6; April 1938) on "The Determination of the Constant of Nutation from the Greenwich Latitude Variation Observations", in which he deals with the material available for the period 1911–36 from observations with the Cookson floating zenith telescope at the Royal Observatory, Greenwich. Dr. J. Jackson had previously utilized the observations from 1911 until 1929 to determine the constant of nutation from the latitude variations and, while his method was closely followed, certain minor alterations were introduced. Amongst these may be mentioned the revision of the star-places and proper motions, the application of corrections for wind and diurnal latitude variations, and the reduction of morning and evening observations to identical epochs. The value of the constant of nutation derived by Jackson was $9{\cdot}2066'' \pm 0{\cdot}0055''$, and that found by utilizing the results up to 1936 is $9{\cdot}2173'' \pm 0{\cdot}0040''$. The latter approaches much more closely the theoretical value than the former which presented a difficulty to Jackson; he described the discrepancy as "one of the outstanding discordances of the constants of the solar system". By using Newcomb's formula, which connects the luni-solar precession, the constant of nutation, the mass of the moon, and the mechanical ellipticity of the earth, the inferred value for the reciprocal of the mass of the moon is 81·53. This is based upon a luni-solar precession for 1900.0 of $50{\cdot}3899''$ found by Newcomb, but according to Oort, who took into consideration the rotation of the galaxy, the value is $50{\cdot}4012''$, from which the inferred value for the reciprocal of the mass of the moon is 81·59. It is hoped that the observations of Eros at the 1931 opposition will provide a more accurate determination of the mass of the moon than that derived by Hinks from the 1901 opposition. As a result, the nutation constant should be found with greater accuracy.

Cambridge Meeting of the British Association

Sectional Programmes

SECTION A (MATHEMATICAL AND PHYSICAL SCIENCES)

THE programme of Section A, as seems appropriate at Cambridge, is less concerned with applied physics than has been the case for a year or two. The opening morning is devoted to a symposium on nuclear physics, in which Niels Bohr and W. Bothe will represent the Continental workers. On Friday, after the presidential address, the Section will divide into two, one part discussing the fundamentals of magnetic theory and the other hearing three papers on subjects of astronomical interest. The first, by Shapley, is on the galaxy, the second is by Ives, and deals with his recent experiments in which the theory of special relativity receives direct support from experiments on the light emitted by positive rays, and the third is an account by R. W. Wood of the new diffraction gratings, which have so improved the technique of astrophysical work with spectrographs. The Saturday morning will find the Section at work on problems of cosmic rays, with an American and a German guest, in the persons of Prof. Furry and Prof. E. Regener. In the second week come symposia on low temperature (particularly that queer material, liquid helium II), and on seismology, the latter taking place at the same time as a further discussion on magnetism, this time jointly with Section G (Engineering).

Those who have missed the general excursions by attendance at the meeting on Saturday will find consolation in the fact that the Section dinner, to be held for the first time, is booked for that evening; they may fill in the afternoon at a garden party in the Observatory. Other visits during the week are to the works of the Cambridge Instrument Co., Ltd., and to the Cavendish and Mond laboratories, where a film of solar prominences will be shown, and a record of the voice of the late Lord Rutherford will be heard.

THE Department of Mathematics has a programme which is exceptionally attractive mathematically. Among the visitors expected are Prof. G. D. Birkhoff, Prof. S. Lefschetz, who will lecture on the fundamental problem of fixed points in topological transformations, Prof. A. Ostrowski, bringing a modification of Newtonian approximation, and Prof. A. Speiser, looking at elliptic functions from the point of view of elementary geometry. The theory of groups and topological algebra are represented further by Mr. P. Hall, Dr. B. H. Neumann, Dr. O. Taussky and Mr. J. H. C. Whitehead, as well as by Mr. M. H. A. Newman, who is to speak on the topological characterization of the sphere in n dimensions, a problem which goes back to Poincaré. Prof. W. V. D. Hodge and Mr. B. Kaufmann have contributions on geometry and analysis, and Prof. E. H. Neville and Mr. D. H. Sadler will follow Prof. Ostrowski.

The Association's Committee on the Calculation of Mathematical Tables, acting through Dr. W. G. Bickley, Dr. J. C. P. Miller and Dr. A. J. Thompson, will take members behind the scenes to look at some of the problems, mathematical and typographical, that come between the simple decision to tabulate a function and the appearance of the printed volume. The National Accounting machine used by the Committee for sub-tabulation and the preparation of printers' copy is to be brought from London for inspection and demonstration, with an operator to explain the adaptations and ingenuities which have effected its conversion from commerce to pure science. Explanations and demonstrations will be given also of a number of other machines, including a model of the Bush integrator, the Mallock equation-solver and Hollerith and other machines; in this exhibition the companies concerned are co-operating with the Association. Interest in the practical side of computation has been expressed and stimulated at Cambridge by the establishment of a mathematical laboratory, and a visit is planned to this embryonic institution.

Lastly, the application of methods and ideas of combinatorial analysis to the planning of biological experiments will be explained in a series of papers by Dr. C. C. Craig, Mr. H. W. Norton, Mr. W. L. Stevens, Mr. F. Yates and Dr. W. J. Youden.

SECTION B (CHEMISTRY)

The president, Prof. C. S. Gibson, in his opening address, will review the recent advances that have been made, chiefly by himself and his co-workers, in the chemistry of gold. This will be followed by a discussion on the recent advances in the organic chemistry of the metals with special reference to the noble metals, in which the principal speakers will be Dr. F. G. Mann, Prof. L. O. Brockway (Pasadena) and Prof. N. V. Sidgwick. Attention will be directed mainly to the electronic and stereochemical aspects of the subject. In the afternoon, Prof. Gibson, with the assistance of Dr. F. G. Mann, Mr. H. V. Thompson and Dr. F. H. Brain will give a demonstration on the production and application of gold films by ancient and modern methods. The processes employed in the ceramic industry and methods depending on the decomposition of organic compounds of gold will be demonstrated. Many specimens will be on exhibition. The demonstration is arranged to be of general rather than purely sectional interest.

A discussion on modern methods of chemical analysis, including physical and microchemical methods, will be opened by Dr. J. J. Fox, Government Chemist. Contributions will be made by Prof. Walther Gerlach (Munich), Prof. Fritz Feigl, Dr. Janet Matthews, Dr. H. Jackson and Dr. K. K. Nygaard (Oslo).

Prof. W. L. Bragg will open a discussion on "Clays". He will be followed by Dr. R. K. Schofield, Dr. Nagelschmidt and Prof. J. D. Bernal. The speakers will deal with the atomic architecture of clay and clay-like minerals, with the origin of the electric charges on clay particles, with base exchange, the absorption and yielding up of water and the behaviour of clays in soils.

The fourth symposium of the meeting, entitled "Repercussions of Synthetic Organic Chemistry on Biology and Medicine", which has an added interest

in view of the exceptional circumstance that the Physiological Section will not meet this year, is being arranged by Prof. E. C. Dodds and Prof. J. W. Cook. Recent work on the production of new compounds having the biological action of the sex hormones will be described by Prof. Dodds and Prof. L. Ruzicka (Zurich), and Dr. A. S. Parkes will deal with some of their interesting biological interrelationships. The second half of the programme will be occupied with descriptions of synthetic compounds which are able to induce cancer (Prof. J. W. Cook), of new compounds having the physiological action of the life-maintenance hormone of the adrenal cortex (Dr. T. Reichstein, Zurich), and of the synthesis of vitamin B_1 and analogous compounds (Prof. A. R. Todd). Specimens and apparatus relating to these discussions will be on exhibition throughout the meeting.

By the kind invitation of Sir William Pope, a visit will be made to the University Chemical Laboratories. Sir F. Gowland Hopkins has also kindly invited the Section to visit the Departments of Biochemistry and Parasitology. Visits will be made to the Cambridge Instrument Co., Ltd., and Messrs. Stewarts and Lloyds' steel works at Corby.

The sectional dinner will be held in Sidney Sussex College, by kind permission of the master and fellows. The following chemists have accepted the Council's invitation to attend as foreign guests of the Association: Prof. G. Bertrand, Paris; Prof. L. O. Brockway, Pasadena; Prof. Fritz Feigl; Prof. Walther Gerlach, Munich; Dr. T. Reichstein, Zurich; and Prof. L. Ruzicka, Zurich.

Section C (Geology)

Up to the delivery of Prof. H. H. Swinnerton's address on "Development and Evolution", the interest of the programme of Section C is mainly on the stratigraphical and palæontological side. After the address the petrological side dominates.

The post-glacial history of the Fenlands is to be considered jointly with Section K (Botany). Short papers dealing with levels and benchmarks, archæological correlations, conditions in Roman times, and the Foraminifera in the deposits, will provide the basis around which the discussion can range.

A more specialized subject is "The Distribution and Migration of Certain Animal Groups in the British Lower Palæozoic Fauna". Dr. C. J. Stubblefield will open and deal with the Trilobites, and Dr. G. L. Elles on Graptolites, Dr. W. K. Spencer on Starfishes and Dr. A. Lamont on Brachiopods will follow. With such experts on these particular groups, important points in palæogeography may emerge.

The association and origin of alkali-rich igneous rocks with limestones has long been of considerable petrogenetic significance. This time the question is to be debated from the opposite angle: "The Origin of the Carbonate Rocks associated with Alkali-Rich Intrusions". Dr. H. von Eckermann of Sweden will open the discussion.

Water supply matters are very much to the fore at the present time. Dr. J. Buchan, in dealing with the underground supplies of London, will show that the progressive lowering of the water-level there is giving rise to concern about the life of the supply. This lowering, also, is leading to a deterioration in quality due to the drawing in of contaminated surface waters.

Among the papers to be given, those concerning some peculiar leucite rocks from Australia, the granites of the Egyptian desert, the palisade diabase sill of New Jersey, and the occurrence of zonal olivines should be of considerable interest.

Section D (Zoology)

Section D (Zoology) will be presided over by Dr. S. W. Kemp, whose presidential address will deal with the future of oceanography.

The item in the programme of the Section which will perhaps arouse the most general interest is a discussion on the mechanism of evolution, extending over a whole day. The range of the discussion will cover such aspects of the subject as the importance of character gradients, selection, orthogenesis, consequential evolution, polymorphism and isolation as factors in the evolutionary process. The speakers include Prof. J. S. Huxley, Prof. R. A. Fisher and Prof. A. E. Trueman.

Prof. J. Gray will introduce a discussion on the role of the environment in animal locomotion, and the papers which follow will treat mainly of the work of the Cambridge school in the analysis of locomotion in aquatic, terrestrial and aerial forms of life. A symposium on sense perception and the evolution of colour and pattern will be introduced by Prof. J. S. Huxley, and contributions from Dr. H. B. Cott, Mr. D. Lack and Mr. I. Burkill will treat of the subject from the point of view of protective coloration, the courtship of birds, and the correlation between insect vision and flower colour respectively.

Dr. H. C. Gilson is to give a semi-popular lecture on the recent expedition to Lake Titicaca.

There will again be an exhibition of biological films of educational interest. These will include two films, produced by the Strand Film Co., Ltd., on mites and monsters and monkey to man, shown by Prof. J. S. Huxley, and films, produced by Gaumont British Instructional Films Co., Ltd., on the liverfluke, the crayfish, and the development of the trout, shown by Mr. H. R. Hewer. An excursion to Wicken Fen and Breckland is included in the programme of the Section for the Saturday of the meeting.

Section E (Geography)

The programme for Section E will be opened by the president, Prof. Griffith Taylor, who proposes to deal with geography as an aid to social problems, history and race. His address will be followed by a number of short papers and a film dealing with the impressions of geographers during the recent visit of the Association to India.

On Friday there will be a series of local papers, including two lectures preparatory to the excursions on Saturday and Sunday. Of these latter the first will be to the north Norfolk coast, while the second will visit the Fens. Monday is to be given over largely to a consideration of the physical factors affecting English ports and estuaries and will include a visit to the Great Ouse Catchment Board.

On Tuesday morning a sectional discussion on "Some Aspects of the Regional Concept" will be opened by Dr. S. W. Wooldridge, while in the afternoon two papers will discuss some particular features of population distribution. On the last morning Dr. Vaughan Cornish will continue his plea for the preservation of coastal scenery, this time at Sidmouth, and Brigadier Macleod will discuss the Departmental report on the Ordnance Survey.

Among individual contributions not already mentioned may be instanced a discussion on the geographical laboratory, to be opened by Prof. F. Debenham, an account of some of the discoveries of the recent Graham Land expedition by Mr. Bertram, and some further results of his work on cirque formation by Mr. W. V. Lewis. The programme includes a much larger number of short papers than usual, and by reason of its wide field should offer many items of interest to members of other sections.

SECTION F (ECONOMICS)

The programme of Section F is very largely given up to the discussion of current matters of public importance, and with the development of statistical and other methods for investigating them.

There will be three papers by Sir William Beveridge, Mr. D. Champernowne and Mr. R. C. Tress on various aspects of unemployment in relation to the trade cycle; its connexion with the local diversity of industry, and its recent trends. The statistical methods of testing trade cycle theories and of measuring the mobility of labour are being discussed by Prof. Tinbergen and Dr. Marschak of the Institute of Statistics, Oxford, respectively. Other topics of current importance under discussion will be public works policy in the trade cycle, the economics of road haulage since the Road and Rail Traffic Act of 1933, and the economic recovery of Germany. Mr. J. M. Keynes has promised a paper on "The Problem of Government Storage of Food Stuffs and Raw Materials".

Mr. R. F. Harrod, the president, is speaking on "The Scope and Method of Economics", a topic which should be of interest in relation to contemporary developments and controversy. The Section has also made arrangements for a discussion of papers on general sociological questions, by Mr. T. H. Marshall on "Professionalism" and Prof. M. Ginsberg on "The Present Position of Sociology".

SECTION G (ENGINEERING)

In his presidential address Prof. R. V. Southwell will deal with the "Changing Outlook of Engineering Science".

There will be a group of papers on problems of vibration, opened by a short paper and demonstration given by Prof. C. E. Inglis. There will be another group of papers dealing with problems in connexion with magnet steels. Major Cook, chief engineer of the Ministry of Transport, will open a discussion with an important paper on the design of roads.

An innovation of great interest is the experiment of including ten short papers by junior engineers who will describe work with which they are intimately connected. Each paper and its discussion will occupy no more than thirty minutes. The meeting will conclude with a lecture and demonstration of engineering instruments given by Mr. Mason of the Cambridge Instrument Co., Ltd.

SECTION H (ANTHROPOLOGY)

The anthropological programme is unusually full, and it has been necessary to arrange several parallel series of lectures. On Thursday morning there will be a general discussion on the Australian aborigines, and a film, recently taken by Dr. Donald F. Thomson, will be shown in the new Arts Theatre. In the afternoon, papers will be read on local archæology, in preparation for the excursions on the Saturday and Sunday.

Friday is given up to two symposia; the topic for the morning meetings is the Swanscombe skull, and for the afternoon, the Middle Palæolithic. In both symposia papers will be read on the geology, skeletal remains and human artefacts. The presidential address will be given on Monday morning by Prof. V. Gordon Childe, and Miss Caton Thompson and Miss Gardner will describe the results of their recent expedition to South Arabia. In the afternoon Sir Arthur Keith will speak on the Mount Carmel skeletons, and on a reconsideration of the Piltdown skull. Other papers will also be given on Cypriote skulls, the stability of English rural population, and on natural selection.

There will be a number of papers on folk-culture on Tuesday morning, and in the afternoon four papers on ritual—ritual and emotion, ritual and tradition, ritual and myth, and ritual and magic. General ethnology will also be represented by a number of contributions on Cambridge, Lapland, West Africa, and Zanzibar, and by papers on boats, primitive art, currency, and on sign language.

SECTION I (PHYSIOLOGY)

The International Physiological Congress is being held at Zurich on August 14–19; it has therefore been decided not to hold meetings of Section I at Cambridge.

SECTION J (PSYCHOLOGY)

Section J (Psychology) has a very full programme. The presidential address, to be delivered by Dr. R. H. Thouless, is entitled, "Eye and Brain as Factors in Visual Perception".

Roughly grouping the other topics, there are papers on social psychology covering the social implications of vocational guidance, friendliness and unfriendliness between different social groups, generalized foreign politics (this last a mathematical analysis) and problems of the social psychology of childhood. General psychology is being dealt with in papers on present trends in American psychology and on hormic psychology, while merging into things therapeutic, we get problems of the mature personality, the background of the problem child, the teaching of mental hygiene through literature, with a turn towards heredity in papers on heredity and mental hygiene and the inheritance of temperament respectively.

Dealing more with the experimental side, are papers on motor learning and the morphology of responses, the direction of thought, a curious pitfall in factor psychology, verbal problems connected with the definition of personal qualities, factors affecting the reliability of interviews, behaviour when attempting difficult tasks, sensory adaptation (in vision and hearing) and colour blindness. Animal psychology is represented by a paper on recent experiments with birds, while there is a joint session with Section L (Educational Science) on the influence of wireless and the cinema on education.

SECTION K (BOTANY)

The botanists and foresters who gather at Cambridge may anticipate an interesting meeting, for a full programme is in prospect. The president,

Prof. W. Stiles, will open the proceedings with his address on the general physiology of the plant cell. This will be followed by the address of the chairman of Department K*, Sir Roy Robinson, who will speak on the supply of home-grown timber.

A number of joint meetings have been arranged. Sections C and K will unite in a meeting on the post-glacial history of Fenland, in which botanical, geological and archæological matters will be discussed. A meeting of Sections D and K, spread over two sessions, will be concerned with the mechanism of evolution, a subject which should provide abundant argument both formal and informal. Botanists and foresters will consider together the relation of ecology and forestry.

A group of contributions on the virus diseases of plants, followed by a discussion, will indicate the present position of this important branch of plant pathology.

In addition to the selected subjects which have been mentioned, many separate communications will be presented. These include series of papers on plant physiology, mycology and palæo-botany, and others on genetics, morphology and ecology.

The foresters (Department K*), in their separate meetings, will devote three sessions to a consideration of the cultivation and utilization of British hardwoods, and a further session to soil problems and to pathology.

Prof. A. H. R. Buller will deliver the semi-popular lecture; he will speak on sex in the rust fungi.

An extensive display of exhibits will illustrate many aspects of botany. It is expected that much of the material will be on view during most of the week, and, during one afternoon session, exhibitors will give demonstrations and explanations.

Excursions to places of interest to botanists and foresters will take place during the meeting, the principal excursions falling on Saturday and Sunday.

Section L (Educational Science)

The greater part of the Section's programme, as in recent years, will be devoted to one or two main subjects; the principal theme for 1938 is "Education for a Changing Society". The speakers on this theme will examine to what extent the education given in the senior, secondary and technical schools aims at preparing their pupils to meet the complex needs of the rapidly changing world of to-day. Miss Dawson of Middlesbrough and Mr. Robinson of Sheffield will speak as heads of senior schools, while Miss Davis of Streatham and Dr. Freeman of Winchester will discuss the contribution of secondary schools. Mr. Paley Yorke of Poplar, Dr. Richardson of Derby and Mr. Frank Pick of the London Passenger Transport Board will analyse the part played by technical education, and Dr. Winifred Cullis will represent the point of view of the universities.

Another outstanding item will be a symposium on Thursday on "Tendencies in School Design", when papers will be read by Mr. S. Urwin of Cambridge, Mr. Denis Clarke-Hall and Mr. W. G. Newton of London and Mr. W. D. Seymour. (In connexion with this subject there will be an exhibition of school models and designs by courtesy of the Royal Institute of British Architects.) A joint session will be held with Section J (Psychology) on the influence of films and wireless on the education of the school child, Mr. R. C. Steele, of the B.B.C., and Dr. P. B. Ballard speaking for Section L.

The president, Mr. J. Sargent, director of education for Essex, will deliver his presidential address on Friday, taking as his subject the "Function of the Administrator". The interim report of the Research Committee on the Informative Content of the Curriculum will be presented at the same session by Mr. H. G. Wells and Sir Richard Gregory.

Section M (Agriculture)

The general theme for all the paper-reading sessions of Section M is "Agriculture in Relation to the Life of the Community". On the Thursday morning there will be a symposium on "Agriculture in Relation to National Employment". Prof. C. S. Orwin will open this and will deal in general with the demands for labour in agriculture. He will be followed by Prof. Scott Watson, who will consider the influence of systems of farming on labour requirements; by Mr. S. J. Wright, who will speak on "Men and Machines" (including transport on the farm); and by Dr. F. Kidd, who will deal with the "Preservation, Storage and Transport of Farm Produce". There will be a general discussion opened by Prof. R. G. White.

On Friday morning, Prof. R. G. Stapledon will give his presidential address, entitled "Lay Farming and a Long Term Agricultural Policy". This will be followed by two papers on soil problems, namely, "Problems of Marginal and Waste Land" by Dr. W. G. Orr, and "The Maintenance of Soil Fertility" by Dr. E. M. Crowther. The general discussion will be opened by Sir Daniel Hall.

Monday morning will be devoted to a consideration of "The Practical Problems of Crop Production", in which Mr. J. A. McMillan will deal with crop husbandry, Prof. F. L. Engledow with the place of plant physiology and of plant breeding in the advancement of British agriculture, and Mr. C. T. Gimingham with crop pests and disease. Sir John Russell will open the general discussion which follows.

On Tuesday morning there will be a symposium on "The Practical Problems of Animal Production". Prof. R. Rae will open this with a paper on animal husbandry. He will be followed by Prof. F. A. E. Crew, who will speak on animal breeding, and by Dr. E. L. Taylor, who will deal with parasitic diseases in animals.

Conference of Delegates

The Conference of Delegates of Corresponding Societies will be presided over by the Right Hon. the Earl of Onslow, and among the principal subjects to be considered are some of wide and national importance. Lord Onslow in his address will deal with "The Importance of National Parks in the Preservation of the Flora and Fauna of Great Britain", while the urgent desirability of the preservation of Crown lands will be especially referred to by Dr. Vaughan Cornish.

Another subject of more than local interest is that of Wicken Fen and what the National Trust has done for East Anglia, upon which Mr. N. B. Kinnear and Dr. M. F. Valentine will speak.

The problem of obtaining periodical and simultaneous field observations over wide areas upon such matters as bird and insect migrations, the prevalence and distribution of wild plant and animal communities

both harmful and beneficial, and the effects upon these of the widespread planning and industrial development of recent years is becoming a matter of significant importance in biological studies; and the co-operation of the corresponding societies in the study of systematics in relation to general biology, which will be discussed in a communication from Mr. H. W. Parker, should prove of assistance and value in effectively ascertaining the desired information by co-ordinated field observations upon specific subjects.

An innovation will this year be introduced at Cambridge when the delegates of the corresponding societies and their guests will dine together, Lord Onslow presiding. They will also attend an afternoon garden party at the Cambridge Botanic Gardens as the guests of Prof. F. T. Brooks. The view has been expressed that the business of the Conference affords insufficient opportunity for that social contact which is considered desirable and can best be attained by such functions.

National Efforts in Cancer Treatment

THE eighth annual reports of the National Radium Trust and Radium Commission, 1936–1937 (published in December 1937)* is of special interest in that it breaks away from the immediate task which confronted it in 1929 and now seeks to guide activities on a broader basis. The following paragraph, taken from p. 23, illustrates this:

"The Commission believes that to secure a reasonable standard of service for the treatment of cancer cases throughout the country there is need for the whole problem to be attacked by the Government along national lines. This belief is supported by the fact that only a proportion of patients suffering from cancer in sites suitable for treatment by radiotherapy are receiving that treatment".

With the resources initially placed at the disposal of the Trust and the Commission, it was decided that a practical beginning to the problem of using radium in the treatment of disease could best be obtained in the way the Commission strove, namely, to secure so far as possible the concentration of radium treatment at the large voluntary hospitals which provide teaching facilities. It was inevitable that this left large parts of the country unprovided with radium facilities, and in consequence centres other than the national centres were set up, so that a glance at the map provided on p. 2 of this report shows 13 national centres, 9 regional centres and one recognized hospital where the Commission has its immediate interests.

In the report for the preceding year, the National Radium Trust, in looking to future needs, stated that "The views of the Radium Commission as to the need for further considerable supplies of radium have received and are receiving anxious consideration, the more so as it seems clear that with the trend towards the use of larger units the ultimate need over the next few years will be far beyond the financial resources of the Trust". The Commission now sees this whole problem of the radiological treatment of cancer looming larger with each succeeding year.

This may occasion little surprise to those who have witnessed at close range the developments of radiological treatment, especially in cancer; but it may well be different for those who, with the constant reminder of cancer statistics in front of them, may question how valid is the warrant for any big extension of these services. The fact is that surgical and radiological methods of treatment are the only two methods which are practised on any scale in Great Britain, and with a death-rate not far short of 60,000 people yearly, it is really an urgent matter to make the most of what we have got. Thirty years ago it was not unusual for people to exclaim as to how gladly money would be given for a cure for cancer. It has not been claimed in any one of the reports which have been issued from the Radium Commission that radium treatment is a cure for cancer, but it is claimed, and supported by the most carefully gleaned (not selected) statistics, that large numbers of cancer patients have been treated with radium and have successfully survived periods of five years. Since cancer is likely to recur in the body it is generally held to be unwise to use the term 'cure', but 'freedom from the disease' is a term which is accepted on a clinical basis, and the 'survival rate' is one which is of the first importance in adjudging the value of any remedial measure.

To return to the belief expressed by the Commission that the treatment of cancer is a problem to be attacked by the Government. This is shared by many people, but the steps by which it could be carried out have never been laid down, and are but hinted at in the report in question. The Commission does, however, state that an increase of bed accommodation at or in association with the existing national centres will be required. The words "at or in association with" suggest, and are probably intended to convey, that any such scheme could only be carried out with the active co-operation, possibly the direction, of the Ministry of Health. It is, in fact, very difficult to see, with the pressure upon the bed accommodation of voluntary hospitals all over Great Britain, how any large increase in treatment facilities could occur without very extensive building and staffing. The position is indeed one which calls for the most sympathetic consideration by the Ministry, because by far the greater proportion of radium therapy carried out at present is done at the voluntary hospitals, the part played by those under the direction of the Ministry being, in fact, relatively small, though doubtless locally very important. If, then, the best that we can offer in the way of treatment for cancer can only be shared by the whole country by the operation of some comprehensive scheme such as that outlined by the Commission, it is a plain duty to be undertaken.

It has been pointed out more than once that the first need of the population is to be fed, the second is to be housed, the third (perhaps) is to be educated. Then comes the question of fitness in health, and unfitness through ill-health. It may well be that the claims of the treatment of people suffering from cancer may be dislodged from the official mind by the claims of the really healthy, that money should first be spent on the attainment of physical fitness rather than on the relief of the sick.

S. RUSS.

* Eighth Annual Reports of the National Radium Trust and Radium Commission 1936–1937, including a Statistical Report. (Cmd. 5612.) Pp. 80. (London: H.M. Stationery Office.) 1s. 3d. net.

Science News a Century Ago

Frédéric Cuvier, For. Mem. R.S. (1773-1838)

FRÉDÉRIC CUVIER, an eminent French naturalist and younger brother of the more celebrated Baron Georges Cuvier, was born at Montbéliard, on June 28, 1773. At his brother's suggestion he went to Paris in 1797, where he attended lectures on physics, chemistry and natural history. In 1802 he became chief editor of the *Journal de la Société d'Encouragement pour l'Industrie Nationale* and was entrusted by his brother with the compilation in collaboration with Duvernay of the catalogue of the animals in the Jardin des Plantes commenced by Buffon and Daubenton. In 1804 he became director of the Jardin des Plantes, where he made some valuable observations on the economy and physiology of the animals, which were published in the *Annales du Muséum*. In 1824 appeared his chief work, written in conjunction with Geoffroy St. Hilaire, entitled "Histoire Naturelle des Mammifères", in which more than five hundred quadrupeds were carefully described. He also published a large number of zoological articles in the "Dictionnaire des Sciences Naturelles" and the volume on "Histoire des Cétacées in "Suites de Buffon". In 1831 he was appointed inspector-general of the Academy, and in 1837 professor of physiology at the Paris Museum of Natural History. He died on July 17, 1838.

Early History of Embryology

IN a retrospective address delivered at the sixth anniversary meeting of the Provincial Medical and Surgical Association held at Bath on July 18–19, 1838, and published in the *Transactions* of the Association, Dr. Jonas Malden, senior physician to the Worcester Infirmary, made the following remarks: "Embryology or that department of anatomy which traces the gradual development of an animal (more particularly of man) from the early stage of intra-uterine existence until it arrives at its perfect formation, is a branch of anatomy almost unknown in this country, although during the last twenty years it has been investigated with great success on the Continent. It is to the labours of the French and German anatomists, more especially those of Meckel and Tiedemann, of Geoffroy St. Hilaire and Serres, that we are indebted for almost all we know upon this interesting subject. Their researches have made known to us the wonderful truth that the intra-uterine being passes through a series of successive changes of existence, beginning with the most simple state, and gradually advancing to the more complicated and perfect. They have shown us that the human embryo at the earliest period of its evolution is analogous to some of the simplest members of the zoophytic class, being nothing save a mere vesicle or globule, filled with a glairy fluid, and exhibiting no appearance of variety of parts; and that, gradually, organ after organ, and system after system, are developed, and more and more completely formed; each successive change representing as it were the structure and formation of an animal higher and higher in the scale of organization".

Death of Pierre-Louis Dulong, For. Mem. R.S.

ON July 19, 1838, the eminent French chemist and physicist Pierre-Louis Dulong died in Paris at the age of fifty-three years. He was born at Rouen on February 12, 1785. In his sixteenth year he entered the famous Ecole Polytechnique in Paris, in which he afterwards was given chairs of chemistry and physics, and held the post of director of studies. In early manhood he appears to have practiced medicine for a time, treating poor patients free, but attracted by the discoveries of Davy and others he devoted himself to chemistry and worked in the laboratory of Berthollet. When twenty-six years of age, he lost an eye through an accident with nitrogen chloride. Much of his work was done in collaboration with his colleague Alexis-Thérèse Petit (1791–1820). Together they made elaborate experiments on mercury and air-thermometers, in 1817 they published a memoir on the rate of cooling of bodies, which was 'crowned' by the Paris Academy of Sciences, and in 1819 they enunciated the law bearing their names, connecting the atomic weight and specific heat of a solid. On Petit's death in 1820, Dulong succeeded to the professorship of natural philosophy at the Ecole Polytechnique, in 1823 he was elected a member of the Academy of Sciences and nine years later was made one of the permanent secretaries. Some of his later researches related to the elasticity of high-pressure steam, afterwards studied by Regnault.

University Events

BELFAST.—The degree of D.Sc., *honoris causa*, has been conferred on Prof. J. P. Hill, professor of embryology, Department of Anatomy, University College, London.

CAMBRIDGE.—H. B. Cott, Selwyn College, and Dr. J. E. Smith (London), have been appointed University lecturers in zoology, and Dr. V. J. Chapman, Gonville and Caius College, University demonstrator in botany.

Prof. F. T. Brooks has been appointed a governor of the National Fruit and Cider Institute until June 13, 1941.

The Benn W. Levy Research studentship in biochemistry has become vacant. Applications for its tenure should be addressed to Sir F. Gowland Hopkins at the School of Biochemistry before July 16.

The Board of Management of the Frank Edward Elmore Fund will shortly proceed to the award of a studentship for research. The studentship is open to male graduates of any university in any country who were born at any place within the British Empire other than Scotland. The Student appointed will work in the Department of Medicine of the University of Cambridge under the direction of the regius professor of physic. The commencing salary will be £300 a year, and the appointment will be for two years in the first instance. Further information may be obtained from the Regius Professor of Physic, Department of Medicine, University of Cambridge, to whom applications, together with three testimonials, a statement of previous appointments, and copies of published papers, should be sent not later than August 1, 1938.

At Sidney Sussex College Dr. R. A. McCance, formerly research student of the College, University reader in medicine, has been elected to a fellowship.

LONDON.—Dr. F. A. Paneth has been appointed, as from October 1, to the University readership in atomic chemistry tenable at the Imperial College—Royal College of Science. Since 1933 he has been a consultant of Imperial Chemical Industries, Ltd., and has been engaged in research work with post-graduate students at the Imperial College.

Societies and Academies

London

Royal Society (*Proc.*, A, **166**, No. 927, 449–589; June 16, 1938).

D. R. HARTREE and W. HARTREE: Self-consistent field with exchange for potassium and argon.

SIR ARTHUR EDDINGTON and G. L. CLARK: The problem of n bodies in general relativity theory.

G. I. TAYLOR: Measurements with a half-pitot tube.

J. G. WILSON: The energy loss of penetrating cosmic-ray particles in copper.

H. J. BHABHA: On the theory of heavy electrons and nuclear forces.

W. HEITLER: Showers produced by the penetrating cosmic radiation.

F. L. ARNOT and MARJORIE B. M'EWEN: The formation of helium molecules.

M. BORN: Application of 'reciprocity' to nuclei.

D. H. BANGHAM and S. MOSALLAM: The adsorption of vapours at plane surfaces of mica. (2) Heats of adsorption and the structure of multimolecular films.

D. H. BANGHAM and R. I. RAZOUK: The swelling of charcoal. (5) The saturation and immersion expansions and the heat of wetting.

(*Proc.*, B, **125**, No. 840, 291–414; June 16, 1938).

R. N. SALAMAN: A discussion on new aspects of virus disease.

A. WALTON and J. HAMMOND: The maternal effects on growth and conformation in shire horse — Shetland pony crosses.

G. O. LANGSTROTH, D. R. MCRAE and G. W. STAVRAKY: The secretion of protein material in the parasympathetic submaxillary saliva.

M. KLEIN: Relation between the uterus and the ovaries in the pregnant hamster.

C. H. WADDINGTON: Studies on the nature of the amphibian organization centre. (7) Evocation by some further chemical compounds.

R. D. PRESTON: The structure of the walls of parenchyma in *Avena* coleoptiles.

C. S. HANES and MARGARET CATTLE: Starch-iodine coloration as an index of differential degradation by the amylases.

Edinburgh

Royal Society, June 6.

ENID CHARLES: Differential fertility in Scotland, 1911–1931. (1) Tables were presented giving gross reproduction rates in 1911 and 1931 for the counties of Scotland, for the total small burghs and landward areas in each county, and for the large burghs and cities. Between 1911 and 1931 the range of fertility in Scottish local areas has contracted and the percentage fall has been greater where initial fertility was higher. The highest current fertility is found in the Clyde industrial area and in some relatively prosperous agricultural regions. The lowest fertility is found where the textile industry is important and in some of the crofting counties.

R. M. NEILL: Food and feeding of the brown trout (*Salmo trutta* Linn.) in relation to the organic environment. A detailed quantitative study of the invertebrate population of a defined river area and of the food of trout therein. The range of the trout's diet —the potential range of which is controlled by the physical environment—is indefinite, covering all the co-existing fauna of its habitat. Species are fed on to an extent depending on their degree of accessibility and the extent of their representation in the fauna. This is sufficient to account for the nature of stomach contents without invoking discrimination on the part of the fish.

V. TCHERNAVIN: Malformations in the adult salmon as a key to the understanding of the fate of smolts during their sojourn in the sea. A detailed examination of two salmon with injured opercula shows the disturbances to be more deep seated than apparent externally. The operculum, preoperculum suboperculum and branchiostegal rays are considerably involved and in one of them the chondrocranium also. The gills on the injured side are much reduced. From a consideration of these and other malformations not infrequent in salmon coming in to spawn, the author concludes that the enormous loss of smolts in the sea is due to periodical catastrophes. Further, that these periods are of short duration and are not the result of a struggle for existence as usually understood.

J. A. MOY-THOMAS and BRADLEY DYNE: The actinopterygian fishes from the Lower Carboniferous of Glencartholm, Eskdale, Dumfriesshire. The actinopterygian fauna of the Lower Carboniferous of Glencartholm, Eskdale, Dumfriesshire, has been re-examined, and the general anatomy of these forms redescribed with particular reference to the dermal skull bones. *Rhadinichthys fusiformis* was found to include *Rh. angustulus* and the Glencartholm specimen of *Elonichthys striatulus*. Three species, *Mesopoma pulchellum*, *M. politus* and *M. crassum* have been separated from the genus *Canobius*. Two new genera, *Paramesolepis* and *Proteurynotus* have been erected. The nature of the bones of the snout region in palæoniscids is discussed and it is concluded that the premaxillary of teleosts is absent in the majority of Palæoniscids.

E. M. ANDERSON: Dynamics of sheet intrusion, with some considerations on faulting. Use is made of C. E. Inglis's formulæ for the stresses surrounding plane cracks, in a solid under tension. These can be applied, with slight modifications, to the case when the crack is filled with fluid under hydrostatic pressure.

GUNNAR DAHLBERG: Rare defects in human populations with particular regard to the inbreeding and isolate effects. A suggested way of decreasing rare recessive defects is prevention of cousin marriage. In a large isolate, there are not many cousin marriages. In a small isolate, on the other hand, there may be many cousin marriages but there cannot be an infrequent gene. These factors are balanced so that the effect of preventing first cousin marriages is a decrease of the very rare defects with a maximum of 30 per cent but, in practice, the figure is expected to be, and is, about 15 per cent. Another mechanism which may decrease the frequency of rare recessives is crossing over boundaries of pre-existing isolates. The frequency of cousin marriages in Germany has decreased from 0·70 per cent to 0·20 per cent in the last fifty years. From this is to be drawn the conclusion that isolates are more than doubled through crossing over their former boundaries. This must have decreased the frequency of rare recessives to less than half its former values. This process has brought about an increase of heterozygotes and a decrease of homozygotes.

Paris

Academy of Sciences, May 23 (*C.R.*, **206**, 1517–1600).

ALEXANDRE GUILLIERMOND and ROGER GAUTHERET: Observations on the action of various colouring matters on living plant cells. Plant cells are permeable to acid colouring matters under special conditions, whilst basic colours penetrate easily. Some fix themselves easily on the cytoplasm and the nucleus and these are the most toxic. Others, less toxic, colour both the cytoplasm and the vacuoles. The least toxic, such as neutral red, accumulate exclusively in the vacuoles.

SERGE BERNSTEIN: The inverse problem of the theory of the best approximation of continued functions.

MARCEL GODCHOT and MLLE. GERMAINE CAUQUIL: The preparation of two stereoisomeric 2,methyl-1,cyclohexanol-1,carbonic acids.

JEAN CABANNES, JEAN DUFAY and JUNIOR GAUZIT: Atmospheric sodium. The sodium found at an altitude of about 130 kilometres is most probably of cosmic origin.

LOUIS COUFFIGNAL: The general solution by mechanical means of the fundamental problems of deductive logic.

FRANÇOIS CHÂTELET: Rational points and the classification of curves of genus one.

MARC KRASNER: A generalization of the local theory of bodies of classes. Conductor law of unicity, law of ordination, law of existence.

JAN POTOČEK: A remark on the reversible chains of Markoff.

DAMODAR KOSAMBI: The spaces of generalized paths which can be associated with a Finsler space.

ALEXANDRE OSTROWSKI: The moduli of zeros of integral functions.

H. HEINS: A theorem of existence in the theory of interpolation.

JULIUS WOLFF: The trajectories defined by the equation $dz/dt = w(z)$ = a holomorph function with real positive part in the demi-plane $D(x>0)$.

KWOK-PING LEE: The directions of Borel of meromorph functions of infinite order.

JEAN DUFAY: The spectra of comet nuclei and the bands of the CH molecule.

JEAN LAGRULA: The values of gravity in the Sahara and the Sudan. Table of results for 58 new stations.

JEAN ROUBAUD-VALETTE: Mass and gravitation.

GEORGES DECHÊNE: Study of a semi-conductor with alternating current.

HENRI MORIN: An oscillator of relaxation with a double grid valve.

JEAN LUCIEN ANDRIEUX and MARCEL CHÊNE: The electrolytic preparation and properties of iron phosphide, FeP. The method described readily furnishes the phosphide FeP in pure crystals.

MLLE. MARGUERITE QUINTIN: The normal potential of cadmium and the radius of the cadmium ion in solutions of the benzene-sulphonate.

ALBERT MICHEL-LÉVY and HENRI MURAOUR: The metallic spectra obtained by shattering explosives.

JEAN LECOMTE: Infra-red absorption spectra of the trisubstituted derivatives of benzene. The symmetry of benzene.

GEORGES CARPÉNI: The ultra-violet absorption spectra and dissociation constants of the α-ketonic enediols. Reductone: reductinic acids: *l*-ascorbic and *d*-gluco-ascorbic acids.

RAYMOND ROHMER: The dehydration of cobalt sulphate with 7 gm.-mol. water. The intermediate hydrates.

ROGER PERROT: The reactional aptitude of nitrosyl chloride.

P. BOISCHOT and G. DROUINEAU: The presence and constitution of ferruginous concretions in a Mediterranean soil.

GEORGES CHOUBERT and LOUIS NELTMER: Phenomena of intrusion and metamorphism in the Pre-Cambrian at Kerdous (Morocco).

MAURICE ROQUES: The discovery of limestones with entrochites and of basic eruptive rocks in the metamorphic schists of Génis (Dordogne).

JEAN COULOMB and GEORGES DUGAST: The variations of terrestrial magnetism accompanying chromospheric eruptions.

PIERRE BERNARD: The solar cycle in microseismic agitation.

PAUL BECQUEREL: Cellular freezing and syneresis.

MME. LUCIENNE LAVIER-GEORGE: Floral anomalies in *Narcissus pseudo-Narcissus*.

PIERRE LASSABLIÈRE, MAURICE UZAN and ALAIN MONNET: The trophophylactic power of certain edible oils towards toxic substances.

MLLE. ANDRÉE DURIVAULT: First contribution to the study of the action of calcium salts on *Alcyonium palmatum*.

ACHILLE URBAIN, RAYMOND CAHEN and JEAN SERVIER: The cryoscopic point of the serum of various mammals.

Cracow

Polish Academy of Science and Letters, April 4.

T. BANACHIEWICZ: (1) The principles of a new technique in the method of least squares. (2) The fundamental relations between the elements of a spherical polygon formed by arcs of small circles.

L. MARCHLEWSKI and B. SKARGYNSKI. The absorption of ultra-violet rays by certain organic substances (47).

K. DZIEWONSKI and W. DYMEK: A method of synthesis of compounds. diaryl derivatives of 2,4-diaminoquinoline.

R. J. WOJTUSIAK and B. FERENS: Experiments on the sense of direction from a distance and the velocity of return in birds. The velocity of return to the nest and sense of direction in swallows (*Hirudo rustica*).

S. SKOWRON: Researches on the endocrine system of the hedgehog (*Erinaceus*). Histological changes in the testicles and the accessory glands of the genital apparatus of the male occurring periodically and under the influence of the endocrine stimuli.

B. JALOWY: Heteroregeneration of the nerve terminations in tactile hairs.

May 2.

T. BANACHIEWICZ: The principles of a new technique for the solution of linear equations.

J. TOKARSKI and MME. H. GAWINSKA: The microplanimetric analysis of Osnick (Volhynia) granite.

W. SZAFER: The Pliocene flora of the Carpathians found at Kroscienko on the Dunajec.

L. MONNÉ: Studies on the vital coloration of *Amœba* (*A. proteus* and *A. dubia*).

MLLE. J. ACKERMANN: Histochemical researches on the lipids and carotenoids in the intestine of the hibernating frog.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

LECTURER IN MECHANICAL ENGINEERING in the School of Engineering, Khartoum—Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1 (July 20), marked "Lecturer in Engineering".

AN ASSISTANT LECTURER AND A DEMONSTRATOR IN PHYSICS in the Manchester Municipal College of Technology—The Registrar (July 22).

LECTURER IN MECHANICAL AND ELECTRICAL ENGINEERING in the Croydon Polytechnic—The Education Officer, Education Office, Katharine Street, Croydon (July 23).

UNIVERSITY LECTURER IN ANATOMY and a UNIVERSITY LECTURER IN PHYSIOLOGY in the University of Cambridge—Dr. F. J. W. Roughton, Department of Physiology, Cambridge (July 25).

UNIVERSITY LECTURER IN PSYCHOLOGY in the University of Cambridge—The Secretary General of the Faculties, The Registry, Cambridge (July 25).

LECTURER IN ZOOLOGY in the University of Glasgow—The Secretary of the University Court (July 25).

GOLDSMID PROFESSOR OF MATHEMATICS at University College, London, to give special attention to a branch of mechanics or applied mathematics—The Academic Registrar, University of London, Senate House, W.C.1 (July 29).

DIRECTOR OF THE CHEMICAL RESEARCH LABORATORY, Teddington—The Establishment Officer, D.S.I.R., 16 Old Queen Street, S.W.1 (August 3).

ASSISTANT WORKS MANAGER at the Cordite Factory, Aruvankadu (Nilgiri Hills) with qualifications in chemistry—The Secretary, Military Department, India Office, London, S.W.1, envelopes marked "Ordnance Recruitment (Aruvankadu)" (Sept. 5).

SENIOR LECTURER IN ECONOMICS in the University of the Witwatersrand, Johannesburg—The Secretary High Commissioner for the Union of South Africa (South Africa House, Trafalgar Square, London, W.C.2) (Oct. 1).

ASSISTANT LECTURER IN PHYSICS at University College, Southampton—The Registrar.

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Proceedings of the Royal Irish Academy. Vol. 44, Section B, No. 10: The Bogs at Ballybetagh, near Dublin, with Remarks on Late-Glacial Conditions in Ireland. By Knud Jessen and A. Farrington. Pp. 205–260. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 4*s*. [276

British Budget, 1938: being an Exposition of the Money System and a Synopsis of the Author's Reformed Scientific National Monetary System (proposed 1926) in 100 Verses. By Dr. Frederick Soddy. Pp. 28. (Oxford: The Author, 131 Banbury Road.) 1*s*. [276

National Union of Teachers, Margate Conference, 1938. Addresses by Dr. Evan Davies, Mrs. Alderman E. Wainwright, F. A. Ring, W. T. Stevenson, His Grace the Archbishop of Birmingham, F. F. Potter, W. J. Hoare, Miss K. M. Halpin. Pp. 72. (London: National Union of Teachers.) 6*d*. net. [276

British Association for the Advancement of Science. The Alexander Pedler Lecture, 1938: Humanity in Geological Perspective. By Prof. H. L. Hawkins. Pp. 12. (London: British Association for the Advancement of Science.) 6*d*. [286

Alkali, etc., Works Regulation Act, 1906, and Alkali, etc., Works Orders, 1928 and 1935. Seventy-fourth Annual Report on Alkali, etc. Works by the Chief Inspectors. Proceedings during the Year 1937. Pp. ii+56. (London: H.M. Stationery Office.) 1*s*. net. [286

Department of Scientific and Industrial Research. Forest Products Research Records, No. 24: African Pencil Cedar; Studies of the Properties of *Juniperus procera* (Hochst.) with particular reference to the Adaptation of the Timber to the Requirements of the Pencil Trade. Pp. iii+9+2 plates. (London: H.M. Stationery Office.) 6*d*. net. [47

City and Guilds of London Institute. Report of the Council to the Members of the Institute for the Year 1937. Pp. lxii+106+3 maps. (London: City and Guilds of London Institute.) [47

National Trust for Places of Historic Interest or Natural Beauty. Report, 1937–1938. Pp. x+114. Properties acquired or protected during the Year 1937–1938. Pp. 16+4 plates. (London: National Trust.) [77

Transactions of the Institution of Chemical Engineers. Vol. 15, 1937. Pp. iv+260+1 plate. (London: Institution of Chemical Engineers.) [77

Other Countries

Bulletin of the Bingham Oceanographic Collection, Peabody Museum of Natural History, Yale University. Vol. 6, Art. 4: Further Observations on the Hydrography of the Eastern Caribbean and Adjacent Atlantic Waters. By Albert Eide Parr. Pp. 29. (New Haven, Conn.: Bingham Oceanographic Foundation.) [246

Field Museum of Natural History. Botanical Series, Vol. 17, No. 5: Studies of the American Flora—1. By Julian A. Steyermark. (Publication 414.) Pp. ii+411–443. 40 cents. Zoological Series, Vol. 20, No. 30: Notes on the Anatomy of the Treeshrew Dendrogale. By D. Dwight Davis. Pp. 383–404. 25 cents. Zoological Leaflet No. 14: Turtles of the Chicago Area. By Karl P. Schmidt. Pp. 24+2 plates. 25 cents. (Chicago: Field Museum of Natural History.) [246

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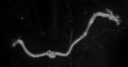
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